Offshore Wind Power Limited

West of Orkney Windfarm Onshore EIA Report

Volume 2, Supporting Study 4: Freshwater Ecology Technical Survey Report

WO1-WOW-CON-EV-RP-0104: Approved by S.Kerr
Document Control 20/10/2023

ASSIGNMENT L100632-S06
DOCUMENT L-100632-S06-A-REPT-004

XODUS

West of Orkney Windfarm

P2022001 West of Orkney Windfarm EIA: Freshwater Ecology Technical Survey Report

Trex Ecology

2 Banks Crescent

Crieff

PH7 3SR

Client

Caledonian Conservation Ltd.

Final Submission Date

May 2023

Authors

Diane O'Leary

Reviewed by

Tommy McDermott

Project team

Tommy McDermott, Diane O'Leary, and Rory Smith.

Table of Contents

P2022001 West of Orkney Windfarm EIA, Freshwater Ecology Technical Survey Report

Trex Ecology

1. Background

1.1. West of Orkney Windfarm

The West of Orkney Windfarm (the Project) is being developed by Offshore Wind Power Limited (Ltd.) (OWPL) and is located approximately 28 kilometre (km) off the west coast of Hoy, Orkney and around 23 km from the north coast of Scotland.

The onshore element requires an underground service corridor to accommodate the export cables from the windfarm to a substation in Caithness. It will comprise:

- Onshore substation located at or near to the existing Scottish Hydro Electric Transmission Ltd. (SHET-L) Spittal substation; and
- Up to five underground cable circuits, no overhead lines are planned for the Project.

This report relates to the Caithness onshore element of the Project only. A suite of surveys is required to identify habitats related to sensitive fish ecological receptors and river habitats that could be impacted by the onshore export cable route. These surveys will be used to assess risks and determine the mitigation requirements within the relevant Environmental Impact Assessment (EIA) Report chapter to be submitted as part of the Planning Permission in Principle (PPP) Application process. The detail and outcome of these surveys have been provided in the relevant supporting studies.

1.2. Project Scope

Caledonian Conservation Ltd. is leading the terrestrial onshore ecology services and commissioned Trex Ecology Ltd. To undertake the freshwater ecology surveys within the Project planning boundary proposed by OWPL. The surveys aim to identify relevant sensitive receptors that could be impacted from all stages of the Project, i.e. construction, operation and maintenance and decommissioning. In addition, the surveys will inform the design of a construction and operational monitoring programme.

The approach to inform the freshwater ecology aspects of the EIA was agreed with the relevant authorities and stakeholders during the Scoping phase of the project and through subsequent consultation. The following was agreed:

- The primary sensitive receptors that will be considered are fish species, in particular, Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), European eel (*Anguilla anguilla*), and all three species of native lamprey (brook (*Lampetra planeri*), river (*Lampetra fluviatilis*) and sea (*Petromyzon marinus*));
- A Desk-Based Assessment (DBA) would:
  i. Incorporate a high-level assessment to identify areas of relevant channels which have the potential to host important life-history stages of all key receptors; and
  ii. Be based on catchment characteristics, such as, reach form, channel slope and land use.
- The walkover survey would involve the following:
  i. A rapid reconnaissance walkover to identify critical fish habitat features, for all key receptors present within the channels identified in the DBA, which may be at risk; and
  ii. In-detail surveys of larger channels to identify important habitats for all receptors within works locations that will require mitigation measures.

The receptors identified during these phases would also be subject to a monitoring plan.

1.3. Project Area

The initial onshore Project area, released in late Spring 2022, is provided below in Figure 1.1, and formed the basis of the area of focus for the DBA rapid reconnaissance walkover survey. The red line denotes the Project cable corridor search area, and the black line incorporates the 250 metre (m) buffer. This was included to ensure that any important habitats which may be connected to Potentially Sensitive Areas (PSAs) were included in the assessment. More formal considerations related to connections to habitats outside the buffer can be taken on a case-by-case basis once the final route has been determined. The onshore Project area underwent a period of further refinement following significant survey work.

Figure 1.2 illustrates the onshore Project area which is applicable to this PPP Application, and this formed the basis for the detailed habitat walkover surveys. Specific crossing locations will be later defined during the detailed design phase once the final onshore export cable route has been confirmed.

Figure 1.1. OPA for rapid reconnaissance surveys

Figure 1.2. Refined OPA for detailed walkover surveys

1.4. Receptors

Fish species and habitats

The main receptors of interest relate to the freshwater life-stages of Atlantic salmon and anadromous variants of the brown trout known widely as sea trout and includes consideration of the juvenile and adult phases of these fish species and their habitats. The seaward return of surviving adults (known as kelts) following spawning is also considered. They are protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act, 2003, and the freshwater phases of salmon are protected within Schedule 3 of the Conservation (Natural Habitats, &c.) Regulations 1994.

The key freshwater life-history stages are:

- Return adult migrations;
- Reproductive behaviours, including spawning and incubation;
- Recruitment of young fish to older cohorts; and
- Juvenile migration downriver and access to the sea.

Other fish species of importance are European eel and lamprey (*Petromyzontiformes* spp.). The European eel is protected under The Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008 and is also protected by measures relating to previous compliance with Council Regulation (EC) No 1100/2007 – *Establishing measures for the recovery of the stock of European eel.* An eel management plan has been produced for Scotland (Department for Environment, Food and Rural Affairs (DEFRA), 2010) in support of this regulation and they are also a priority species for conservation in the Scottish Biodiversity List[1] (NatureScot, 2020). They are listed as *Critically Endangered* (Jacoby & Gollock, 2014) by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Up-to-date information on their distribution and abundance in Scotland is sparse and despite their well-known presence within Scottish fauna, very basic elements of their ecology and behaviour are still only being uncovered (e.g. Wright *et al*., 2022). In the absence of further information, the presence of eel should be assumed.

Brook and river lamprey (*Lampetra* spp.) are related lamprey species commonly found in Scotland. Brook lamprey completes their entire life cycle within freshwater, while river lamprey migrates to coastal areas, parasitising marine fish before returning to local rivers to spawn. The sea lamprey (*Petromyzon marinus*) is a much larger fish but displays a similar life history to the river lamprey. Although none of these species holds specific protected status other than restrictions on their method of capture (Schedule 3 Conservation (Natural Habitats, &c.) Regulations 1994) (as amended), they can form the basis of protected area designations elsewhere in Scotland. They are also listed as priority species for conservation on the Scottish Biodiversity List. All three species use discrete silt accumulations as juvenile habitat and can occur within the same patch; assuming adults can access that area. There is some discussion on whether brook and river lamprey may be life history variants of the same species (Maitland, 2003), or at least pair species (Hume *et al*., 2013).

Their distribution is well understood in broad terms; however, there is some evidence that they may be absent from the onshore Project area (Hume, 2017). However, as standard mitigations to protect the species align with those for other species, they have been retained. Given the absence of widespread sampling programmes utilising specific surveys for the three species, a precautionary approach here is valid.

[1] The Scottish Biodiversity List is a list of animals, plants, and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland.

1.5. Purpose of this document

This document presents the results of the rapid reconnaissance survey and the detailed habitat survey. This documents also outlines the sensitivity of the freshwater ecological receptors to potential activities arising from the delivery of the Caithness onshore element of the Project. It will also inform the mitigations required, which will be presented within the relevant EIA Report chapter, and the Aquatic Monitoring Plan which will be developed, approved and implemented based on consultation with relevant consultees at the post-consent stage.

2. Method

2.1 Introduction

The method to be employed during the freshwater ecology baseline data collection was agreed at Scoping and is based on an initial DBA, followed by field surveys.

A Habitat-Based Approach (HBA) was proposed and agreed at the Scoping stage and through subsequent consultation with the relevant authorities and stakeholders[2] for the field survey element. The fundamental purpose of the HBA is to provide a time-invariant description of the potential for channels to host receptors indicated by the presence of key, discrete habitat elements linked to their specific life-history stages agreed at the Scoping stage. It precludes the requirement for a direct survey. The reason for this is that the presence and distribution of fish species, which often migrate between fresh and saline environments (diadromy – salmon, sea trout, river and sea lamprey, and eel) or which can undertake significant in-catchment migrations (brown trout), are often subject to inter-annual variation at multiple spatial scales (river reach to oceanic basins). Therefore, the absence of these fish in a given year does not guarantee their absence in successive years. However, the absence of suitable habitat (e.g. accumulations of mobile coarse substrates for spawning) does limit their distribution across the medium temporal scale.

2.2 Desk Based Assessment

Trex Ecology undertook a DBA in the spring of 2022 to determine potential areas of risk for fish populations. This was to prioritise subsequent field surveys using available mapping and other datasets (Table 2.1). There is no standard DBA methodology available when assessing channel suitability for fish habitats. However, best judgement by experienced staff was used to assess the available data based on observed deposition features, channel slope, catchment position, channel typology, channel reference typology, and overall catchment form. Therefore, it is subjective, but guided by objective data.

Each of these two catchments (Forss and Thurso) within the onshore Project area was reviewed for potential fish importance based on the channel characteristics described above. Priority 1 was assigned to the mainstem or a high-order channel with appropriate low slopes. Priority 2 was assigned to the mainstem or high-order channel with areas of increased slope. Priority 3 was any channel subject to significant high slopes or too small to realistically host significant fish populations.

The findings from this assessment formed the basis of the rapid reconnaissance surveys which are summarised in Section 3.2.

2.3 Review of available information

A separate desktop review was undertaken to assess available information on the presence of important and relevant ecological receptors in the area or other factors, such as the Water Framework Directive (WFD) Status Classifications, which could influence the outcomes of this report. It also highlights key regulatory information which should be understood. The sources of data assessed are detailed below in Table 2.1.

[2] Marine Scotland, NatureScot, Marine Scotland Science, The Highland Council, Caithness and Northern District Salmon Fishery Board (DSFB), and Offshore Wind Power Limited.

Table 2.1. Data sources assessed

Asset	Location	Date accessed	Purpose
NatureScot Site Link	https://sitelink.nature.scot/map	Aug 2022	Identify relevant protected areas/species
Scottish Environment Protection Agency (SEPA) WFD data	https://www.sepa.org.uk/data-visualisation/water-environment-hub/	Aug 2022	Identify current WFD status
SEPA river barrier locations	https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1746	Aug 2022	Identify channel barriers to fish migration
Marine Scotland salmon map	https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=843	Aug 2022	Salmond distribution map
Marine Scotland National Electrofishing Programme Scotland (NEPS) data	https://scotland.shinyapps.io/sg-national-electrofishing-programme-scotland/	Apr 2022	NEPS Survey overview

2.4 Surveys

Rapid reconnaissance walkover

The rapid reconnaissance walkover was used to provide a high-level assessment of potentially sensitive channel reaches and to record key habitat criteria which could be impacted by the Project's activities. These features included the presence and composition of deposition features, salmonid and lamprey spawning habitat, juvenile lamprey habitat, and instream structures such as Large Woody Debris (LWD), debris dams, and bank undercuts. The presence of pressures such as weirs, fords, morphological alteration (e.g. straightening) and poaching was also included. These features were recorded using a "point and line" based approach. A list of these features is provided in Appendix A.

Detailed habitat walkover

The findings of the rapid walkover surveys were used to inform the requirement for more detailed habitat walkovers in conjunction with the ongoing refinement of the cable corridor.

The habitat walkover took the form of an adapted "Hendry & Cragg-Hine" (Environment Agency, 1997) approach to identify important fish features. It was developed and updated in England but is demonstrably suitable for rivers across the British Isles in this updated format and has been widely used across Scotland by Trex Ecology.

The approach has been adapted for several reasons. Firstly, the feature definitions from the 1997 method are dated and do not reflect the current scientific understanding of habitats and processes which lead to those habitats. Secondly, the approach has been made more robust by incorporating elements of the River Habitat Survey (RHS) (Raven *et al.*, 1998) and River Habitat Assessment Technique (RHAT) (Toland *et al.*, 2008), allowing for a longer-term determination of habitat presence, which is more resistant to seasonal factors and provides a more rounded multi-species assessment.

These features included the flow types and in-channel features such as barforms and islands and were recorded using a "polygon" based approach. A list of these features is provided in Appendix A.

2.5 Data recording

Findings from all surveys were recorded using ArcGIS Field Maps App. Channel survey tables were created on ArcGIS home and exported to the Field Maps App hosted on iPads Version 7. An offline version of the survey areas was then created and stored on the iPads, ensuring feature collection would continue in the absence of mobile reception. The iPads were geolocated using a Garmin Glo GPS/Glonass portable receiver attached via Bluetooth. System redundancy was provided by iPhones (SE and 11), meaning that data collection could continue using the same approach if the iPads ran out of battery power.

2.6 Site visits

The surveys were undertaken on the following periods:

- Rapid walkover surveys: May and early June 2022; and
- Detailed habitat walkovers: July 2022 with an additional walkover undertaken in September 2022 to accommodate a change in the Project area boundary.

The survey team consisted of two surveyors using a combination of Trex Ecology staff members: Tommy McDermott (team lead), Diane O'Leary (team lead), Rory Smith (team member) and Kirsty Menzies (team member).

The weather conditions and river levels were favourable for the surveys. There were some occasions when the clarity of the water or depth made it difficult to fully assess the riverbed during the reconnaissance walkover. However, points were reviewed during the detailed habitat walkovers and amended if deemed necessary.

The optimum time for survey is February to May so that features are not obscured by vegetation. As this timeline was not possible, vegetation growth was significant during the detailed habitat walkovers and certain reaches could not be surveyed confidently.

3. Results

3.1. DBA

Protected areas and relevant species

The Salmon Act

All channels within the assessment area are potentially subject to the requirements of the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act, 2003, aka the Salmon Act; irrespective of whether they are located within a protected area, such as a Special Area of Conservation (SAC). Under this, it may be an offence to, recklessly or otherwise, interfere with the spawning and migration of anadromous salmonids. It also protects spawning habitats. This act is regulated by the local DSFB, in this instance the Caithness DSFB.

Forss Water catchment

There are two Sites of Special Scientific Interest (SSSI) within the Forss catchment. Westfield Bridge is notified for its nationally important fen meadow and calcareous grassland vegetation. Loch Lieurary SSSI is designated as a representative of basin fen habitat and is one of the largest areas of this habitat in Caithness. Loch Calder SSSI, which is on the western boundary outside of the Project area, is designated for the nationally important populations of wintering geese and swan that roost on the loch. Loch Calder is also included within the Caithness Lochs Special Protection Area (SPA) for the same qualifying interests. Although none of these designations relates directly to the receptors in this report, the SSSIs are connected to river habitats.

Thurso catchment

The River Thurso is a SAC designated for Atlantic salmon. The SAC is currently assessed as *Unfavourable Recovering* condition, with overgrazing and forestry as causal pressures. The river is also designated as a SSSI at its lower reaches, recognised for the nationally important floodplain fen habitat and flowering plants that grow along the margins and banks of the river.

According to the SAC Citation, *'the Thurso supports a higher proportion of multi sea-winter salmon than is found in many rivers further south in the species' range'*. The northerly location and the cooler water temperature result in slower-growing juveniles, which take longer to smolt with evidence from elsewhere that these slower growing, older smolts may return as older multi sea-winter salmon (Welton *et al*., 2001). In addition, grilse (single sea-winter fish) also return to the River Thurso, meaning that the river can support both broad sub-populations of salmon life-history types.

Water Framework Directive

There are three Water Bodies (WBs) within the study area as defined by the SEPA for regulatory purposes (WFD) (see Table 3.1 below). However, it should be noted that not all channels capable of hosting receptors and their habitats are assessed under WFD in Scotland, with only those over an 11-ha catchment size receiving a designation.

Table 3.1. SEPA waterbodies and current overall condition status within the Project area

WB ID	Name	Overall Status
20633	Forss Water – Allt Forsiescye	Good
20637	Thurso – Loch More to sea	Good
20642	Halkirk Burn, Thurso catchment	Moderate

The Rivers Forss and Thurso are listed at *Good Overall Status*, supporting the view of mostly functionally intact WBs with sufficient quality to sustain quality river biotic communities over the long term. Halkirk Burn WB, in the Thurso catchment, is listed as *Moderate*, downgraded for Physical Condition and also a reduced ecological quality based on "impacted" fish communities. No further information on the downgrade is provided.

Obstacles

There is one marked barrier within the Caithness Project area on the SEPA barriers database available on the Marine Scotland Science (MSS) map portal (National Marine Plan Interactive (NMPi); MSS, 2021a). This is within the Forss catchment and is recorded as a passable natural barrier, the Forss Falls. The Falls (ND 03676 68679) are approximately 1.5 km upstream of the estuary at Crosskirk (see Appendix B, map B1.11). No other barriers are listed; therefore, all channels within the Project footprint should permit access to migratory salmonids and other diadromous fish (based on the DBA). However, barriers are often unrecorded and become apparent during surveys.

Salmond distribution

The salmonid distribution database available on the MSS map portal NMPi (MSS, 2021b) indicates that salmon are "Present" in the Forss Water, the River Thurso, Burn of Halkirk, Calder Burn and "Likely Present" in the Burn of Sour.

National electrofishing programme for Scotland

A review of the most recent available regional NEPS data from 2019 (Malcolm *et al.*, 2020) shows widespread salmon access across the search area. This data indicates the presence of both fry (salmon hatched in the year in question, also called 0+ fish) and parr (juvenile fish hatched prior to the year in question, >0+ fish). This indicates that local rivers are regularly supporting spawning by salmon. The picture with respect to trout is less clear; however, both species use broadly the same habitats, and the presence of one usually supports the conclusion that habitat is available for both species. The distribution of salmon juveniles recorded in 2019 is shown in Figure 3.1, and juvenile trout distribution is shown in Figure 3.2.

It should be noted that the data presented in Figure 3.1 and Figure 3.2 are based on a randomised sample design with a small number of fixed sites (surveyed every year), and additional sites as a changing set making up the remaining yearly surveys. Therefore, spatial coverage is not total. However, these data show the widespread presence of salmon and trout juveniles throughout the Project area, albeit with highly variable density. This view is supported by additional information provided on the Salmon Map (MSS, 2022), showing assumed salmon presence in rivers not covered by NEPS in 2019 (Malcolm *et al.*, 2020).

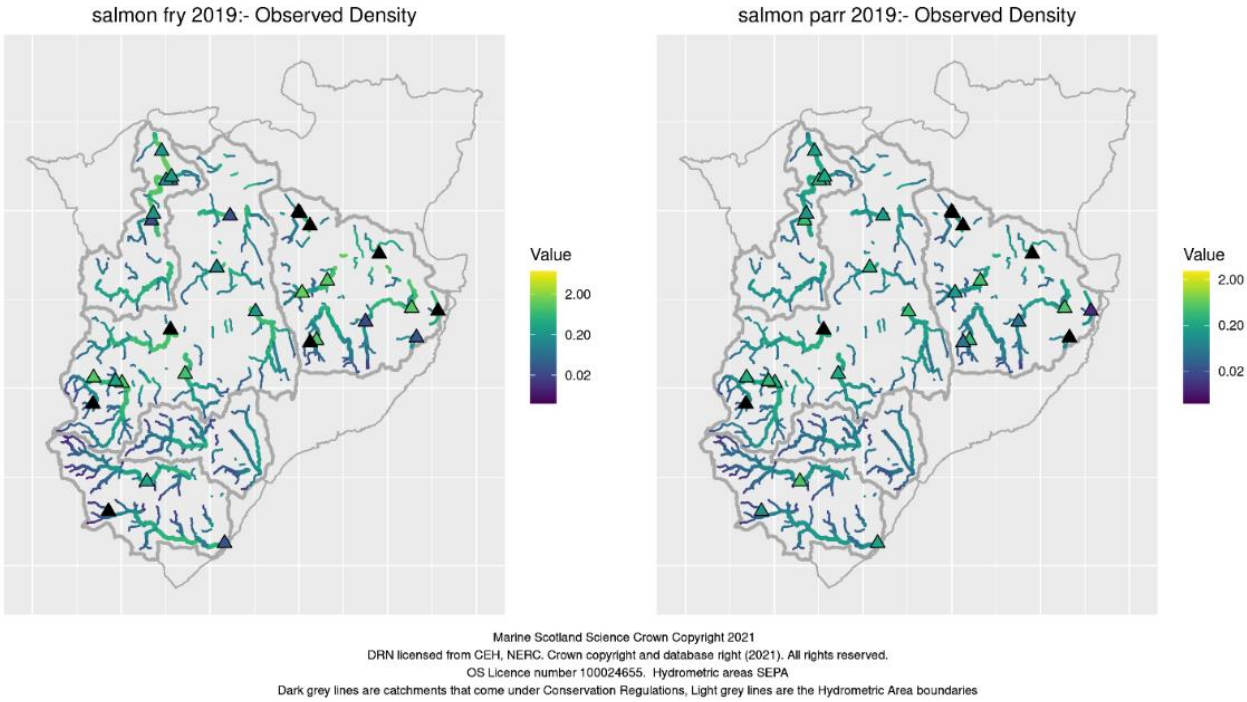


Figure 3.1. Screenshot from NEPS Shiny App, Caithness District Juvenile Salmon Distribution, 2019

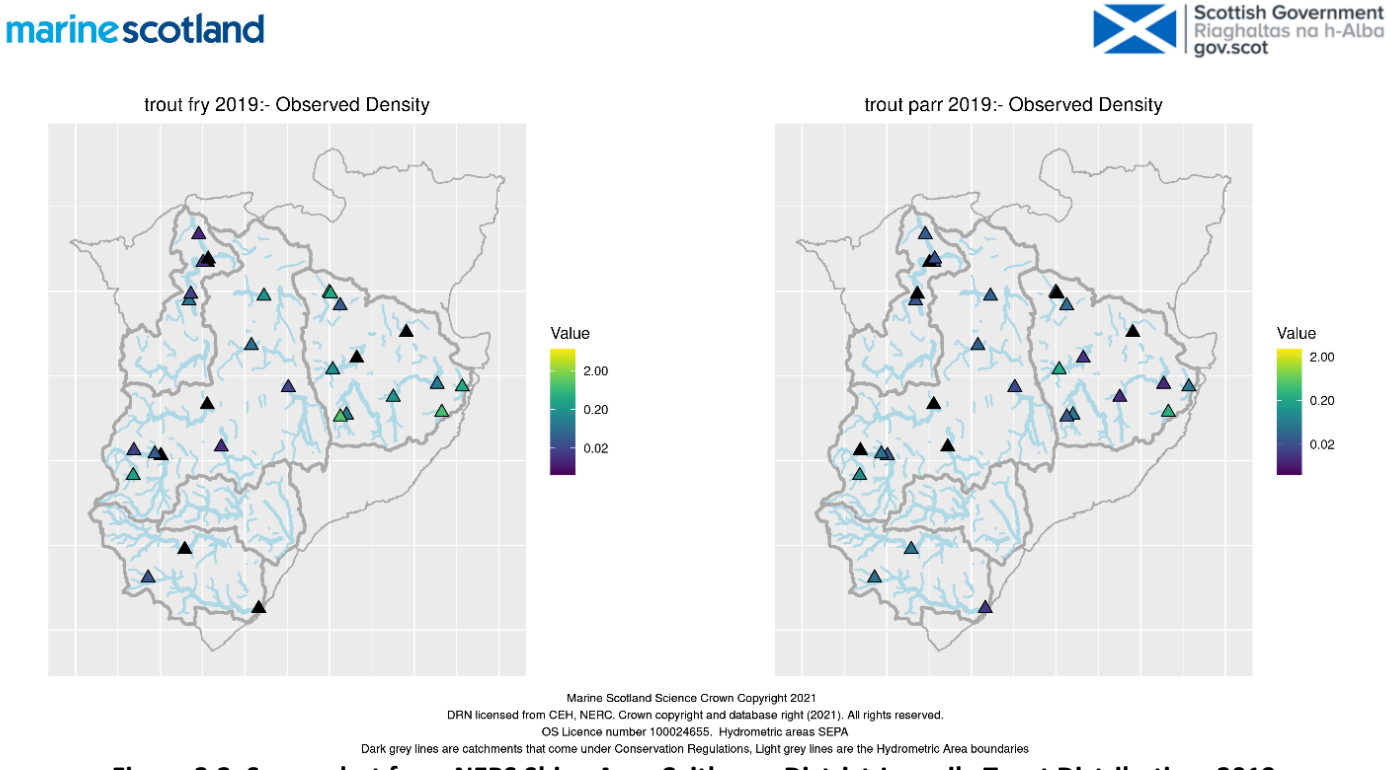


Figure 3.2. Screenshot from NEPS Shiny App, Caithness District Juvenile Trout Distribution, 2019

3.2. Survey results

Desk-Based Assessment

As outlined in Section 2.2 a high-level prioritisation was used to identify areas of relevant channels which have the potential to host important life-history stages of all key receptors. This assessment was used to focus the rapid reconnaissance walkover surveys in the Forss and Thurso catchments.

Forss catchment

Six channels (Figure 3.3) within the Forss catchment were assessed, the mainstem of the Forss Water and several of its tributaries. Forss Water offers the main opportunity for fish migration and spawning habitat and therefore has been assigned as Priority 1. The tributaries are mostly on steeper ground and offer less ecological potential and have been assigned either Priority 2 or 3.

Thurso catchment

The River Thurso, four of its tributaries, and a channel in the northwest (Figure 3.4) of the catchment were assessed. The majority of the mainstem of the River Thurso has been assigned Priority 1. The tributaries are highly modified channels and are, therefore, mostly Priority 2 and 3 due to the reduced ecological potential of these types of channels. The channel in the northwest is a straightened channel and has been classed as Priority 3.

Rapid reconnaissance walkover

The rapid reconnaissance walkovers were undertaken on the twelve watercourses identified within the defined Project area during the DBA exercise; six channels in each of the Forss and Thurso catchments. The twelve channels were assigned a colour-coded priority system: Priority 1 – high (green), Priority 2 – medium (yellow), and Priority 3 – low (orange). The list of channels that were surveyed is provided in Table 3.2, and Table 3.3. shows the prioritised lengths in meters for each catchment. The colour-coded channels can be seen in Figure 3.3 and Figure 3.4.

As outlined in Section 2.4, the rapid reconnaissance survey used a 'point and line' based approach to record key habitat criteria, along with the presence of pressures. Details of the findings for each watercourse in The Forss and Thurso catchments is provided below, with associated maps provided Appendices B-M.

Table 3.2. Rapid survey: channel names and codes

Catchment	Channel ID	Channel name	Survey distance (m)
Forss Water	ML21	Forss Water	10,925
	ML22	Hallam Burn	1,648
	ML27	Burn of Brimside	808
	ML23	Burn of Baillie	1,191
	ML26	Unnamed Burn by Loch Lieurary	1,128
	ML25	Alltan Ghuinne	1,071
River Thurso	ML34	River Thurso	8,482
	ML38	Burn of Carnavagry	1,049
	ML31	Burn of Sour	1,283
	ML33	Calder Burn	3,486

Catchment	Channel ID	Channel name	Survey distance (m)
	ML37	Burn of Halkirk	4,474
	ML36	Burn of Achanarras	4,655

Table 3.3. Rapid survey, prioritisation in metres by catchment

Catchment	Priority	Length (m)
Forss	1	12,888
	2	5,083
	3	0
Thurso	1	14,486
	2	8,481
	3	1,452

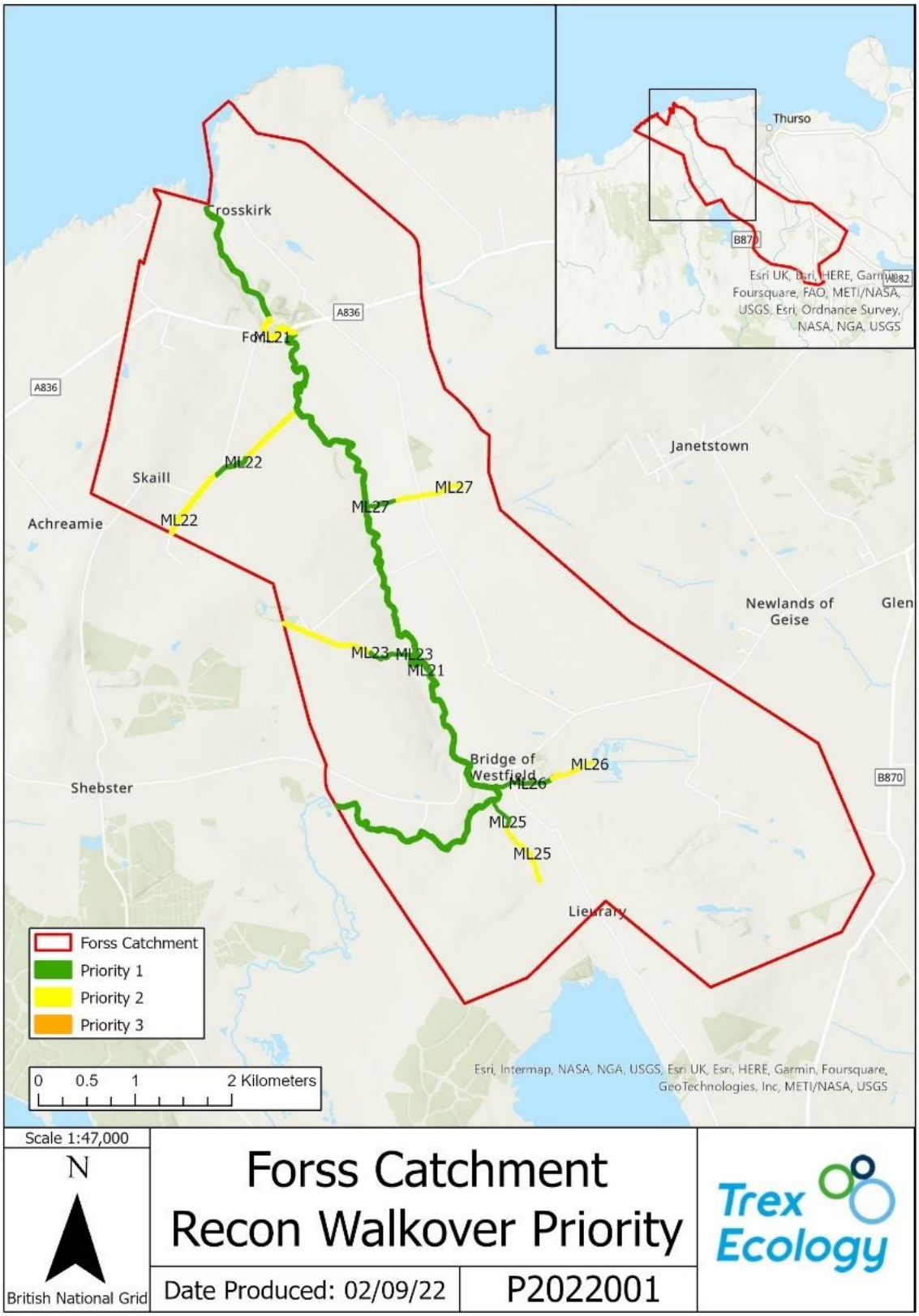


Figure 3.3. Channels within Forss catchment - rapid reconnaissance survey

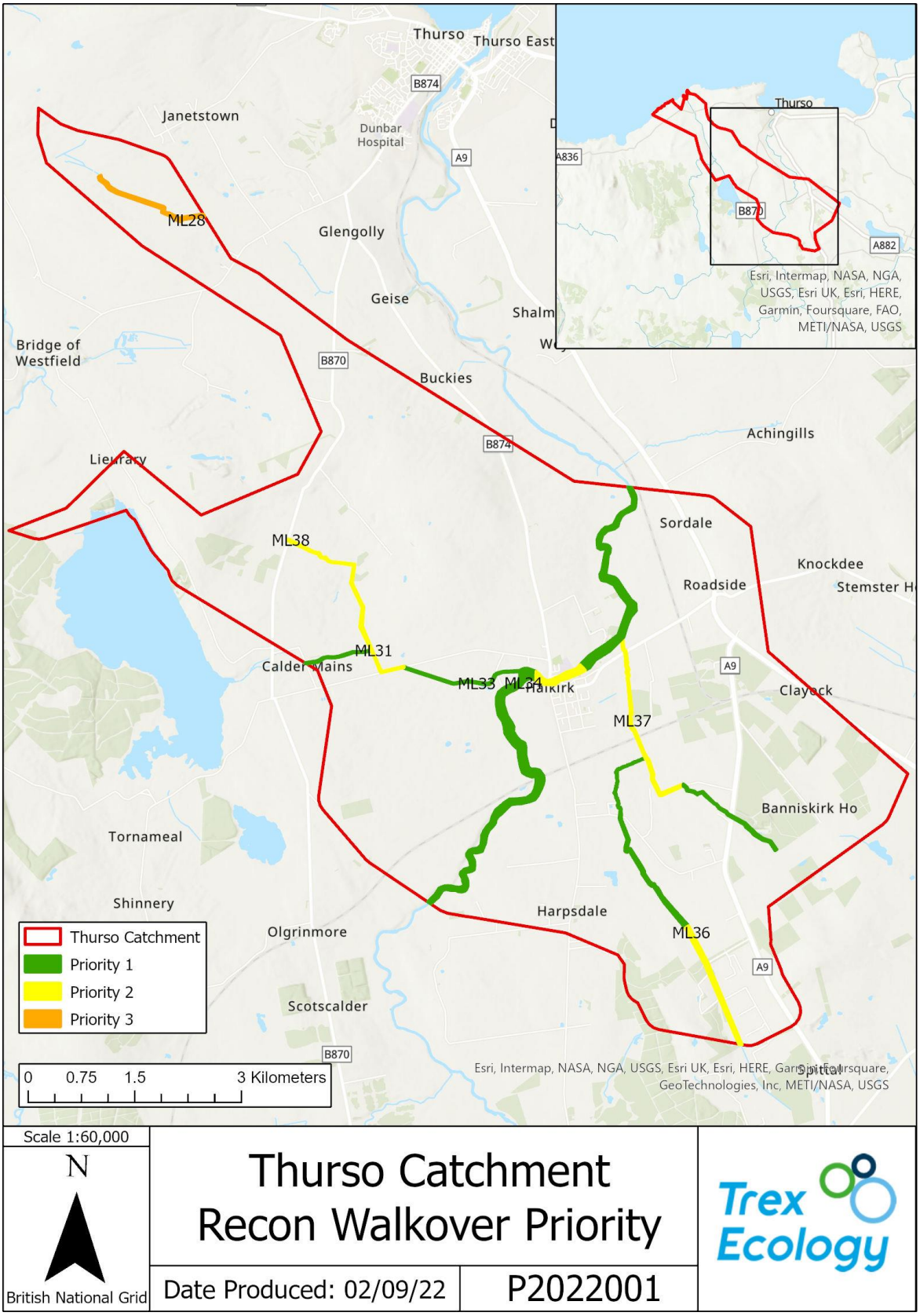


Figure 3.4. Channels within Thurso catchment - rapid reconnaissance walkover survey

Detailed habitat walkover

The detailed habitat walkover survey was undertaken within the more defined Project area due to the results of the rapid reconnaissance surveys and the ongoing refinement of the cable corridor route (see Figure 1.2). The watercourse crossing points were yet to be refined at the time of the survey (and remain so at the time of writing).

As outlined in Section 2.4, the detailed walkover survey used a 'polygon' based approach to record key habitat criteria, e.g. the flow types and in-channel features such as barforms and culverts (see Appendix A for the list of features). In addition, the points from the rapid walkover surveys were reviewed and amended where appropriate, e.g. a spawning point may have been added or removed where water clarity and depth allowed for a clearer assessment than was sometimes the case during the rapid survey.

The survey sites for the Forss and Thurso catchments are listed below in Table 3.4 and shown in Figure 3.5 and Figure 3.6. Details of the findings for each watercourse in The Forss and Thurso catchments is provided below, with associated maps provided in Appendix B and C.

Table 3.4. Channels surveyed for detailed habitat walkover

Catchment	Channel ID	Channel name	Survey distance (m)
Forss Water	ML21	Forss Water	7,847
	ML22	Hallam Burn	690
	ML27	Burn of Brimside	560
	ML23	Burn of Baillie	1,182
River Thurso	ML34	River Thurso	4,573
	ML38	Burn of Carnavagry	655
	ML31	Burn of Sour	1,283
	ML33	Calder Burn	830
	ML37	Burn of Halkirk	2,216
	ML36	Burn of Achanarras	3,560

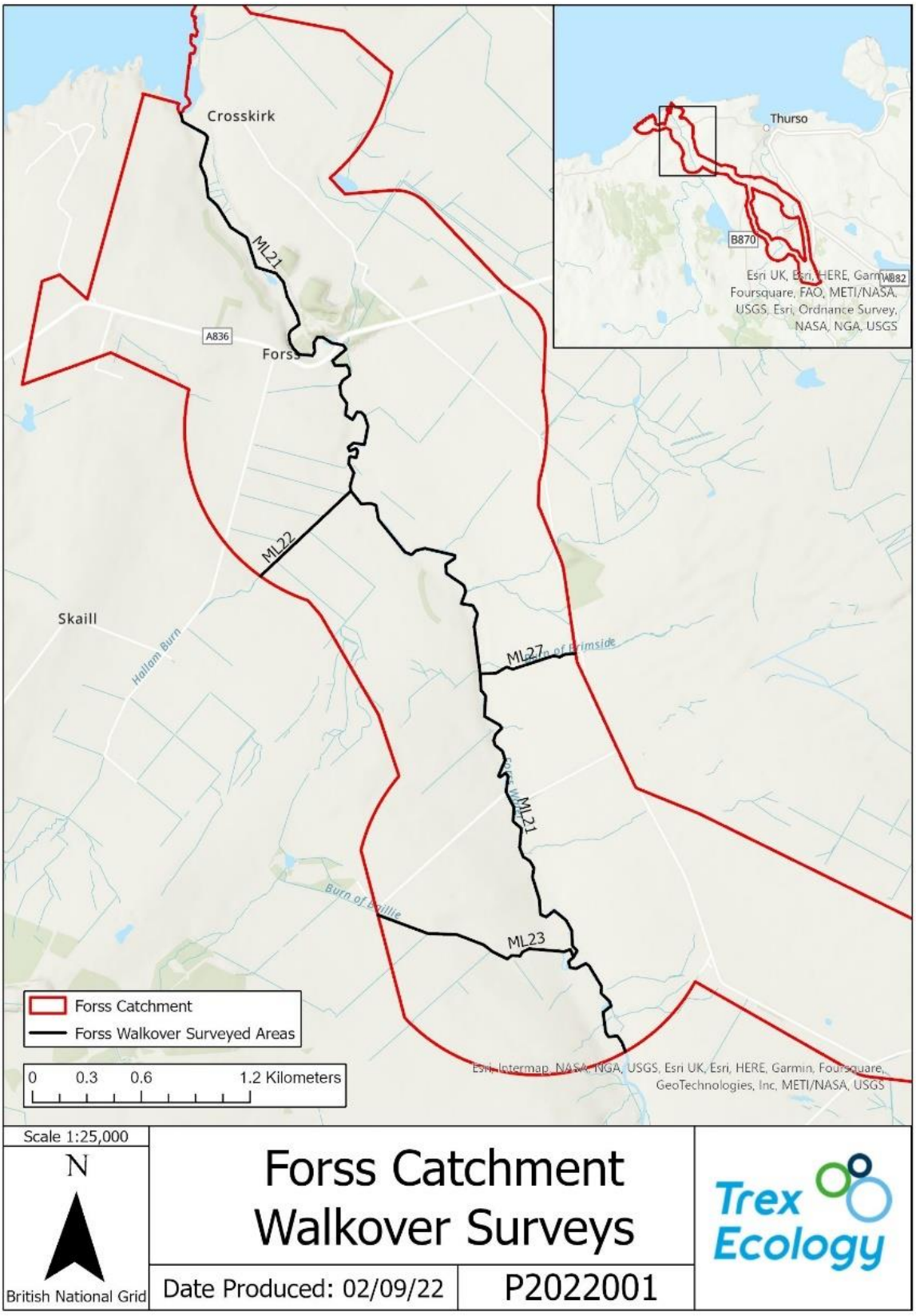


Figure 3.5. Channels within Forss catchment requiring detailed habitat walkover surveys

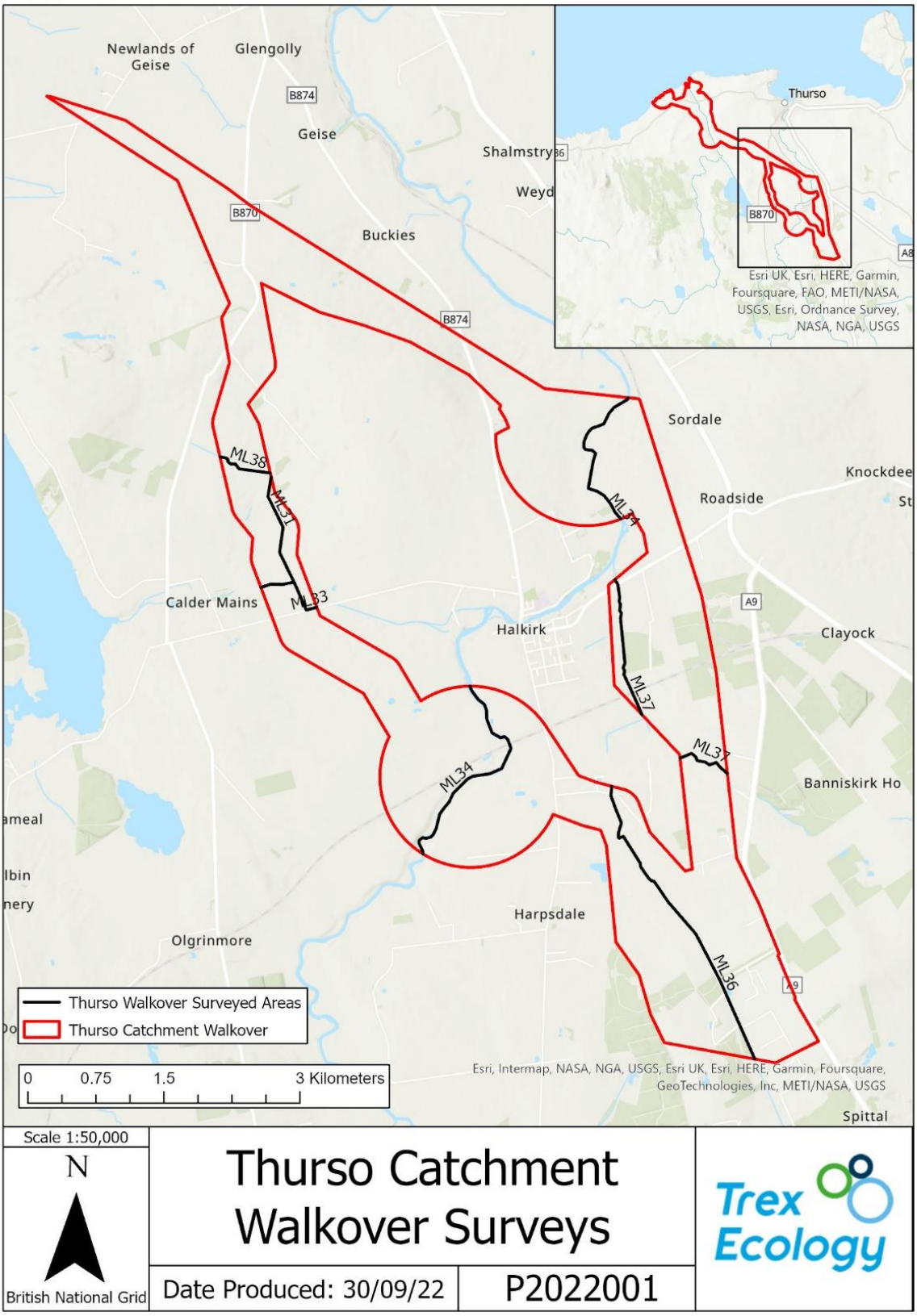


Figure 3.6. Channels within Thurso catchment requiring detailed habitat walkover surveys

Forss Catchment

Forss Water

The rapid reconnaissance survey area for the Forss Water was approximately 11 km in length and extended from Crosskirk Bay to around 4 km southwest of the Bridge of Westfield (see Figure 3.3, Figure 3.7 and associated results map in Appendix B). The detailed walkover survey was undertaken along 7.8 km of the river, from Crosskirk Bay to approximately 1 km downstream of the Bridge of Westfield (see Figure 3.5, the inset map in Figure 3.8 and results maps in Appendix B).

Figure 3.7. Forss Water, Forss Falls

From the Bridge of Westfield to the confluence with the Burn of Baillie, the Forss demonstrates channel complexity, with depositional features such as barforms and islands and several backwater sections. The flow regime in this section is diverse, with riffle, run, and glide sequences throughout the reach. The substrate is dominated by boulders and cobbles, with very few areas suitable for salmonid spawning habitat.

The river meanders through low-lying fields (see Figure 3.8) between the confluence of the Burn of Baillie towards the road bridge on Lythmore Road. This section has many barforms and areas of exposed bedrock, adding complexity to the flow regime. Similar to the upper reach, there are riffle, run, and glide sections but also pools and rapids. Along with boulder and cobble areas, there are also sections of cobble and gravel which offer several areas of habitat suitable for spawning.

Figure 3.8. Forss Water, detailed walkover survey, July 2022

The section between the road bridge at Lythmore Road and the Bridge of Forss is also diverse from a habitat perspective. The river forms pools, rapids, exposed bedrock, and backwaters along with riffle, run, and glide sequences. Bedrock, boulder and cobble are dominant throughout this section but with some accumulations of gravel/pebble substrates, more than in the upper reaches. There are many points recorded as suitable juvenile salmonid spawning habitat throughout this section and a concentration of points within 1 km of the Bridge of Forss. There were also small areas of juvenile lamprey habitat recorded closer to the Bridge of Forss, where there were silt deposits.

The Falls are a large complex cascade, with crest modification on the right-hand bank necessitating the recording of a weir. Below the falls, the river meanders adjacent to woodland with riffle, run, and glide sequences with salmonid spawning habitat evident throughout this section. Downstream of this, the flow regime becomes less diverse, flowing as a slow, deep glide before discharging to the sea at Crosskirk with some salmonid spawning habitat and juvenile lamprey habitat present. The Falls are not a complete barrier to fish passage.

Hallam Burn

Hallam Burn (ML22) is a tributary of the Forss Water and is situated in the northwest of the Forss catchment (see Figure 3.3 and the inset map in Figure 3.9). It flows through agricultural land, primarily rough pasture and arable. In the upper reaches of the survey area, the burn runs alongside a minor road.

The rapid reconnaissance survey was undertaken from the confluence with the Forss to 1.5 km upstream (see Figure 3.3, the inset map in Figure 3.9 and associated results maps in Appendix B). The detailed habitat survey was undertaken on 0.7 km of the burn, again from the confluence with the Forss to 0.7 km upstream (see Figure 3.5, inset map in Figure 3.10 and associated results maps in Appendix B).

Figure 3.9. Hallam Burn, Forss catchment

During the detailed walkover, short sections of the burn were not visible due to the level of summer vegetation growth (see Figure 3.10), but this did not affect the overall survey. The flow regime was mostly glide/run sequences with occasional short sections of riffle. Some 'no perceptible flow' areas were recorded, primarily due to in-stream vegetation. The habitat condition was poor, with extensive levels of algae affecting the visibility of the substrate, caused by warm, low summer flows and inputs from agriculture or septic tanks.

Exposed boulders and bedrock were prevalent in the upper reaches, with silt present to varying degrees throughout the burn. The silt made it difficult to see the other substrates within sections, but gravels were evident towards the confluence with the Forss, where juvenile salmonid spawning habitat was recorded during the rapid survey along with one point recorded as juvenile lamprey habitat. The silt loads may have an impact on redd survival, should salmonids choose to spawn here.

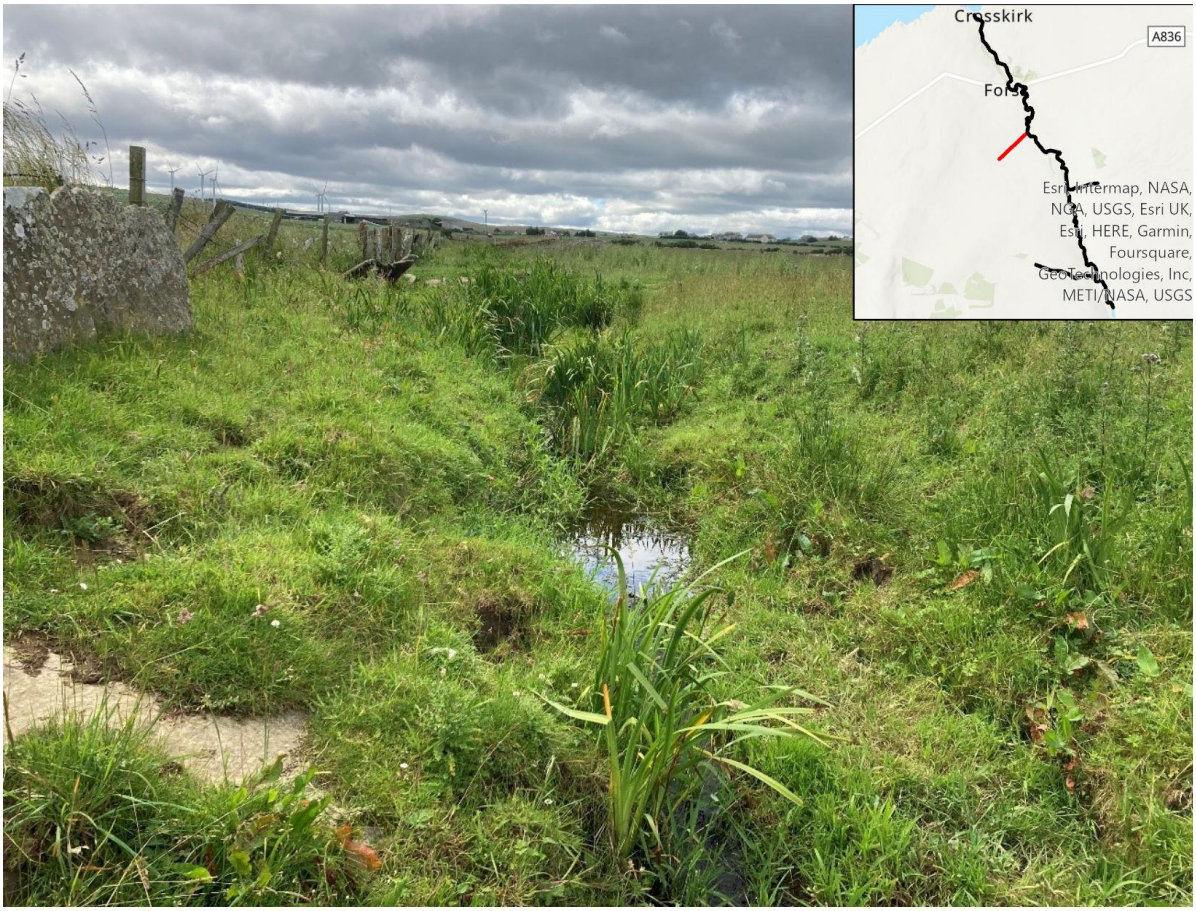


Figure 3.10. Hallam Burn, detailed walkover survey, July 2022

Burn of Brimside

This Burn of Brimside (ML27) is on the east side of the catchment (see Figure 3.3, inset map on Figure 3.11 and associated results maps in Appendix B). It was mostly dry at the time of the survey and therefore marked as unsuitable for fish. The reason for the dry channel was not established but no further surveys were conducted.

Figure 3.11. Dry Burn of Brimside, Forss catchment

Burn of Baillie

The Burn of Baillie (ML23) flows through agricultural land (see Figure 3.3, inset map in Figure 3.12 and associated results map in Appendix B). The survey area for this burn was approximately 1.2 km; however, due to landowner access restrictions, most of this burn could not be surveyed. The upper section, which could be viewed from the road, showed a highly modified and straightened burn, which was overgrown with vegetation that restricted the visibility of the watercourse. This suggests that the watercourse may be enriched with related reductions in ecological quality.

Figure 3.12. Burn of Baillie, Forss catchment

Unnamed Burn by Loch Lieurary

The burn by Loch Lieurary (ML26) is located on the east of the Forss catchment, just downstream of the Bridge of Westfield. It flows west from the Loch Lieurary wetland area through woodland, rough pasture, and marshland to its confluence with the Forss. Only a rapid reconnaissance survey was undertaken at this burn as it fell outside the Project area during the refinement of the cable corridor route. The survey area was approximately 1.1 km (see Figure 3.3, the inset map on Figure 3.13 and associated results maps in Appendix B).

Figure 3.13. Unnamed burn by Loch Lieurary

The upper and lower reaches demonstrate different characteristics, as shown in Figure 3.14 and Figure 3.15. The upper burn is highly modified; realigned and embanked, with areas of hard reinforcement.

There is a woodland section with several records of LWD and debris dams. Such organic jams can force the formation of salmonid spawning habitat onto unsuitable channel typologies (Buffington & Montgomery, 2013), but none was recorded in this section. However, some juvenile lamprey habitat was recorded further downstream of the woodland area. The burn then flowed through a large concrete culvert under the road.

The lower channel had no evidence of modification, and it meandered through marshland. There were several areas of erosion, LWD and juvenile lamprey habitat. Three salmonid spawning habitat points recorded.

Figure 3.14. Upper reach of the unnamed burn by Loch Lieurary

Figure 3.15. Lower reach of the unnamed burn by Loch Lieurary

Alltan Ghuinne

The Alltan Ghuinne (ML25) flows through areas of improved grassland and rough pasture from Loch Calder to its confluence with the Forss Water (see Figure 3.3 and inset map in Figure 3.16 and associated results maps in Appendix B).

Only a rapid reconnaissance survey was undertaken as the burn fell outside the Project area during route refinement; therefore, a detailed survey was not required. The survey area was approximately 1 km.

The burn has been highly modified with areas of realignment and embankments, and one culvert is present. There are areas of undercut banks, with bank erosion particularly evident in the lower reaches near the confluence with the Forss. Livestock poaching was prevalent throughout the survey

area. Some individual trees were present in the survey area but there was no evidence of LWD. Limited spawning habitat was present, primarily in the lower reaches.

Figure 3.16. Alltan Ghuinne, Forss catchment

Thurso Catchment

River Thurso

The River Thurso (ML34) rapid reconnaissance survey area was approximately 8.5 km long and extended from upstream by Achardale to downstream towards the A9 by Sordale, approximately 8 km south of where it enters the sea at Thurso Bay (see Figure 3.4, the inset map in Figure 3.17 and associated results maps in Appendix C). The detailed walkover survey was undertaken along 4.6 km of the river, split into two areas. The upper section, approximately 2.5 km, is situated southwest of Halkirk. The downstream section, approximately 2 km long, is located northeast of Halkirk (see Figure 3.6, inset map in Figure 3.18 and associated results maps in Appendix C).

A long, deep glide dominates the upstream survey area, but there is some variation in flow for approximately 350 m, with sequences of riffle, run, and glide. Within this section are several depositional features in the form of small, vegetated islands, adding some complexity to the river and, consequently, several areas of salmonid spawning juvenile lamprey habitat were recorded. The long deep glide from this section flowed for approximately 1.5 km, with just a couple of points recorded for lamprey habitat. Another short section follows this with a number of small islands and associated salmonid spawning habitat. The glide continues with areas of potential lamprey habitat. As the river approaches the end of the survey area, it meets a section of exposed channel bedrock with shallow, fast flows (see Figure 3.18).

The downstream survey area northeast of Halkirk was more complex than the upstream section, with riffle, run, and glide sequences throughout and depositional features in the form of barforms throughout the reach. Salmonid spawning habitat was recorded throughout this reach, along with areas of juvenile lamprey habitat.

Figure 3.17. River Thurso at Halkirk

Figure 3.18. River Thurso, exposed bedrock channel form

Burn of Carnavagry

The Burn of Carnavagry (ML38) is located on the west of the Thurso catchment and flows through a mix of marshland and rough pasture. The rapid walkover survey covered just over 1 km from the B870

to the confluence with the Burn of Sour (see Figure 3.4, the inset map in Figure 3.19 and associated results maps in Appendix C). The detailed survey encompassed 0.6 km from the east of the B870 to the confluence with the Burn of Sour (see Figure 3.6, the inset map in Figure 3.20 and associated results maps in Appendix C).

Figure 3.19. Burn of Carnavagry, Thurso catchment, July 2022

Channel modification is a significant feature of this burn. The flow regime is characterised by run/glide sequences interspersed with short cascades in the upper reaches, and riffles in the mid and lower

reaches. The burn had a mix of substrates with boulders and bedrock evident in the lower reaches (Figure 3.20). There was extensive silt throughout the burn, potentially due to the level of livestock poaching recorded. Salmonid spawning habitat was concentrated in the upper section of the survey extent, along with one point for juvenile lamprey habitat. In the mid-section of the survey area, approximately 200 m of the burn was not visible due to overgrown vegetation.

Figure 3.20. Burn of Carnavagry, detailed walkover survey, July 2022

Burn of Sour

The Burn of Sour (ML31) is located on the west of the Thurso catchment and flows through marshland, rough pasture and arable land. The rapid walkover survey area was approximately 1.3 km in length from the confluence with the Carnavagry Burn to its confluence with Calder Burn downstream (see

Figure 3.4, the inset map in Figure 3.21 and associated results maps in Appendix C). No changes were made for the detailed survey (see Figure 3.6, the inset map in Figure 3.22 and associated results maps in Appendix C).

Figure 3.21. Burn of Sour, Thurso catchment

The burn is highly modified. It is realigned throughout the whole survey extent, along with large sections of embankment and small areas of reinforced bank. There was little bank erosion, but livestock poaching was evident throughout.

The burn is dominated by run/glide sequences with short riffle sections (Figure 3.22). The channel was densely vegetated in several sections, resulting in reaches with no perceptible flow and short sections

that were not visible to survey. Boulder, bedrock and cobble substrates dominated the middle reaches with gravel/pebble and silty substrates in the upper and lower reaches where salmonid spawning and juvenile lamprey habitat was recorded.

Figure 3.22. Burn of Sour, detailed walkover survey, July 2022

Calder Burn

The Burn of Sour becomes the Calder Burn (ML33), where it flows from west to east to meet the River Thurso. Calder Burn flows through rough pasture and marshland. The rapid survey walkover extent was approximately 3.5 km from 500 m east of the B870 to the confluence with the Thurso (see Figure

3.4, the inset map in Figure 3.23 and associated results maps in Appendix C). The detailed walkover was only required on 0.8 km of the burn. The survey area extended from 400 m west of the confluence with the Burn of Sour to downstream, where the burn meets a minor road (see Figure 3.6, the inset map on Figure 3.25 and associated results maps in Appendix C).

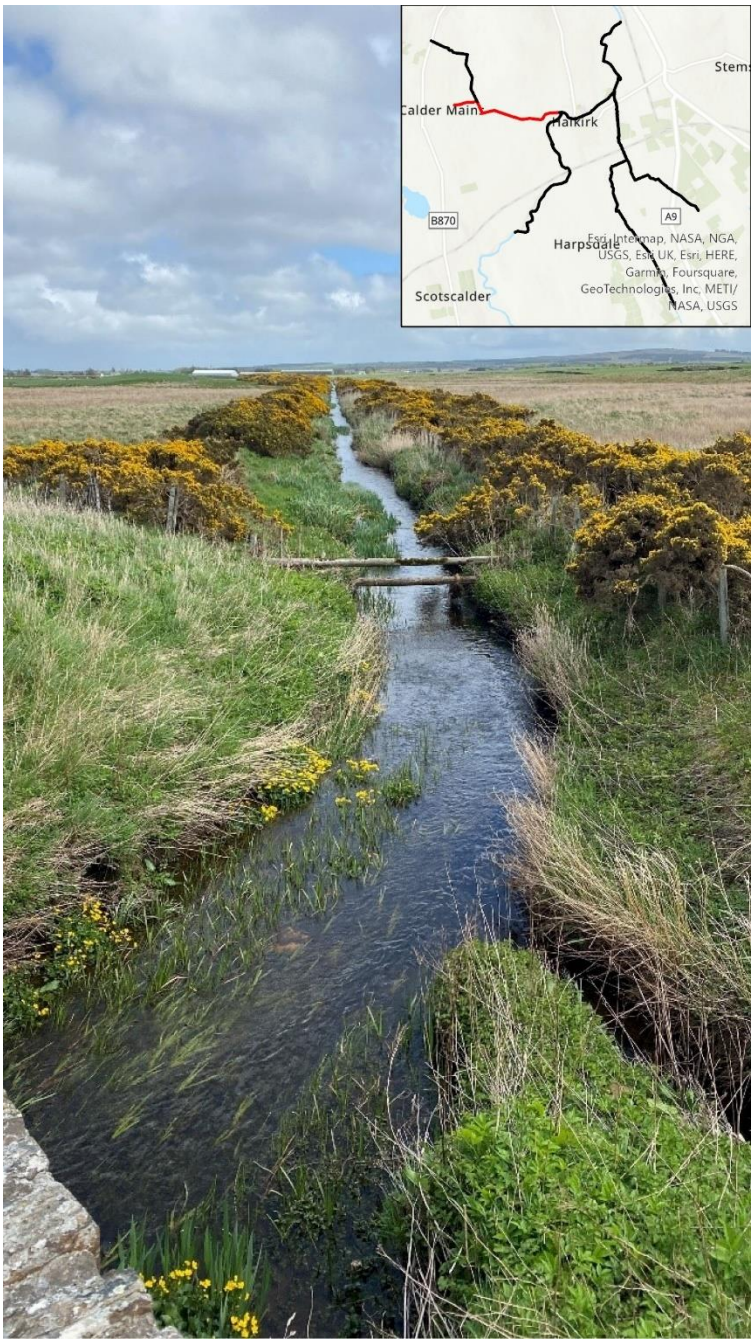


Figure 3.23. Calder Burn, Thurso catchment

At the upstream extent of the survey area, the burn runs through a short section of woodland, with in-channel LWD and debris dams. These structures were driving in-channel flow diversity and providing deposition zones. Varied flow regime with riffle, run, and glide sequences with

predominantly gravel/pebble substrates were accompanied by silt, providing the suitable habitats for juvenile salmonids and lamprey.

From here, the burn runs through marshland and rough pasture, with poaching throughout this reach, along with several sections of bank erosion. There was a concentration of salmonid spawning and juvenile lamprey habitat just by the confluence with the Burn of Sour.

Downstream of this, the burn becomes highly modified and has been realigned as far as the confluence with the Thurso. There are several sections of embankment, hard reinforcement, and bank erosion in these lower reaches. Livestock poaching is common and only a couple of areas of potential salmonid spawning habitat and juvenile lamprey habitat were recorded.

Figure 3.24. Upper Calder Burn, detailed walkover survey, July 2022

Figure 3.25. Lower Calder Burn, detailed walkover survey, July 2022

Burn of Halkirk

The Burn of Halkirk (ML37) is located approximately 1 km east of Halkirk village and south of the River Thurso. It runs through low-lying marshland and rough pasture. The rapid walkover survey was approximately 4.5 km; from just east of the A9 to the confluence with the River Thurso (see Figure 3.4, the inset map in Figure 3.26 and associated results maps in Appendix C). Two sections of the burn were later surveyed as part of the detailed walkover; 0.6 km extending from 100 m west of the A9 to 700 m downstream of the road in July 2022 (see Figure 3.6, the inset map in Figure 3.27 and associated results maps in Appendix C); and 800 m downstream, a 1.5 km section towards the confluence with the Thurso. This downstream section was surveyed in September due to a change in the ongoing refinement of the cable corridor route. (See Figure 3.6, the inset map on Figure 3.28 and associated results maps in Appendix C).

Figure 3.26. Burn of Halkirk, Thurso catchment

Figure 3.27. Burn of Halkirk, detailed walkover survey (upstream section), July 2022

The upstream survey was complex with riffle, run and glide sequences and barforms throughout the survey area. Gravel/pebble was the dominant substrate throughout. Salmonid spawning habitat was

recorded throughout the burn, with concentrations at the upper and lower reaches in particular. Several records of LWD were also present, adding to the complexity of the site, and juvenile lamprey habitat was noted.

Figure 3.28. Burn of Halkirk, detailed walkover survey (downstream section), September 2022

The second survey area (Figure 3.28), approximately 800 m downstream, also demonstrated a diverse flow regime with riffle, run, and glide sequences but had no visible depositional features. However, it is more modified with sections of channel realignment and embankments, a passable weir by the railway bridge and a culvert under the road bridge. Despite this, areas of undercut banks and erosion suggest that some renaturalisation could occur. Salmonid spawning habitat was recorded throughout this survey area, with lamprey juvenile habitat at the downstream end.

Burn of Achanarras

The Burn of Achanarras (ML36) is located in the south of the Thurso catchment and is a tributary of the Burn of Halkirk. The burn flows through a rough pasture and marshland and runs parallel to the Spittal substation.

The rapid walkover survey area was approximately 4.5 km, extending from upstream of the Spittal substation to the confluence with the Burn of Halkirk (see Figure 3.4, the inset map in Figure 3.29 and associated results maps in Appendix C). The detailed survey covered 3.5 km and started upstream of Spittal substation to 100 m downstream of the minor road by Houstry (see Figure 3.4, the inset map in Figure 3.30 and associated results maps in Appendix C).

Figure 3.29. Burn of Achanarras, Thurso catchment

The upper reaches are highly modified, characterised by a narrow, straightened, and embanked channel. Downstream of the road bridge at Houstry, the burn follows a less artificial course with meanders and areas of erosion, but also livestock poaching. There were also small sections of hard reinforcement and a small, passable weir. No overhanging trees were recorded.

During the detailed assessment, upstream reach by Spittal substation could not be surveyed due to overgrown vegetation affecting visibility. Downstream, the visibility improved, and the flow regime for most of the survey area comprised a diverse flow with riffle, run, and glide sequences. The section just downstream of a culvert under the road by the substation is characterised by a higher energy flow regime with sequences of riffles and cascades, and this is repeated further downstream, incorporating a small pool. The flow regime reverts to repeating units of riffle, run and glide sequences in the middle and lower reaches. The majority of the salmonid spawning habitat was found in the mid and lower sections, along with lamprey habitat in the lower reaches.

Figure 3.30. Burn of Achanarras, detailed walkover survey, July 2022

3.3. Results summary

Forss catchment

The Forss Water is characteristic of a meandering spate river with areas of erosion and deposition. These features contribute to a diverse flow regime providing substrates throughout much of the survey area that would support salmonid spawning, and habitat suitable for juvenile lamprey was

observed throughout the reaches downstream of the Bridge of Westfield. Upstream of this bridge, the river is dominated by bedrock with little to no spawning habitat. There were very few trees to provide shade to keep the river cool in hot summer temperatures. The lack of trees means no LWD recruitment, which would add to the dynamics of the river, potentially offering more opportunities for more salmonid spawning habitat and increased resilience to climate change by creating deeper water pools and direct shade. The Forss Falls are recorded as passable for salmon, but passability will be linked to flows, and changes to rainfall patterns may change passability over short and longer terms.

The Burn of Brimstone was mostly dry with limited scope for spawning habitat. This burn should be excluded from monitoring, unless the pressure taking all the water from the burn is mitigated. The Burn of Baillie was not accessible due to landowner restrictions; however, the part of the burn that could be seen from the road was a highly modified, straightened channel that was overgrown with vegetation, and the watercourse was not visible.

The Hallam Burn was dynamic and meandering in the lower reaches with repeating units of glide/run sequences with short sections of riffle. There were stretches with no perceptible flow due to in-stream vegetation, a seasonal impact. The habitat condition was poor, with extensive levels of algae affecting the visibility of the substrate. The upper reach of the survey extent was a highly modified realigned channel dominated by bedrock and boulders with no spawning habitat recorded.

The upper reach of unnamed burn by Loch of Lieurary is highly modified. Although it runs through woodland in this reach with LWD and debris dams, the substrate was not of the quality to support salmonid spawning. The lower reach has not been straightened and meanders through marshland. There are several areas of erosion, depositional features and LWD here. Salmonid spawning and juvenile lamprey habitat were recorded in this lower reach. This burn was scoped out for the detailed habitat walkover as it was outside the revised cable corridor boundary.

Alltan Ghuinne is a highly modified, realigned channel running through farmland. Stock poaching was prevalent throughout, and much of the riverbed consisted of bedrock. Some spawning habitat was recorded in the lower reaches towards the confluence with the Forss. This burn was scoped out for the detailed habitat walkover as it was outside the revised cable corridor boundary.

Thurso catchment

The River Thurso runs a natural course through peatland and rough pasture. There are very few to no trees along the riverbanks, and bank erosion and stock poaching were evident throughout the survey area. A long, deep glide dominates the upstream survey area, followed by a section of more dynamic flow, with depositional features providing both salmonid spawning and juvenile lamprey habitat. This is followed by a section of exposed bedrock with a more energetic flow regime with freefall sections along with riffles and runs. The downstream survey area has repeating units of riffle, run, and glide sequences with depositional barforms and habitat conducive to salmonid spawning and juvenile lamprey habitat.

The upper reaches of the Burn of Carnavary follow a natural meandering form and are characterised by run/glide sequences interspersed with short cascades in the upper reaches and riffles in the mid and lower reaches. Livestock poaching was prevalent, with silt present throughout the burn. There were some points considered suitable for salmonid spawning and just one for juvenile lamprey

habitat. The burn has been straightened in the lower reaches, with the habitat considered to be unsuitable for spawning.

The Burn of Sour is a highly modified channel, with long sections of embankment with evidence of stock poaching throughout the survey area. The burn is dominated by run/glide sequences with just a few short riffle sections along with several areas of no perceptible flow due to in-channel vegetation. Salmonid spawning habitat was predominantly recorded in the burn's upper reaches, where sufficient gravels along with silty areas suitable for juvenile lamprey habitat were present.

The upper extent of the Calder Burn flows through a short section of woodland, offering the complexities of LWD, debris dams, and a varied flow regime providing good habitat for salmonids and juvenile lamprey. The lower reaches of the burn are highly modified, with stock poaching as a recurring feature and in-channel vegetation resulting in fewer points recorded for salmonid and juvenile lamprey habitat.

The majority of the Burn of Halkirk is modified with extensive embankments and realignment. However, only two short sections of the burn were re-surveyed for the detailed habitat walkover. The upstream section exhibited a much more complex meandering form with a diverse flow regime, depositional features, and pieces of woody debris. This, combined with gravel and pebble substrates, provided spawning habitat throughout the survey area in addition to areas suitable for juvenile lamprey habitat. The section downstream also demonstrated a diverse flow regime with riffle, run, and glide sequences but had no visible depositional features. This lower section is more modified, but evidence of natural processes occurring provides habitat suitable for salmonid spawning throughout this survey area, with lamprey habitat at the downstream end.

The upper reaches of Achanarras Burn are highly modified and characterised by a high-energy flow regime with sequences of riffles and cascades. The middle and lower reaches follow a more natural meandering course to the confluence with the Burn of Halkirk,with repeating units of riffle, run and glide. There are areas of stock poaching and bank erosion in this area. Only a few points of salmonid spawning and juvenile lamprey habitat were recorded for this burn, which was in the middle and lower reaches.

4. Discussion

4.1. Caveats and survey limitations

The reconnaissance walkover surveys were undertaken in the spring and were based on the Project's initial broadscale onshore export cable corridor zone, which encompassed portions of the Forss and Thurso catchments.

The detailed walkover was undertaken in July, within the more defined area, as the scope of the cable corridor continued to be refined. At the time of the survey in July, the exact crossing points were still unknown. Once detailed design is undertaken following consent, the survey area around the crossing points should encompass 100 m upstream of the crossing point, the crossing point itself and 500 m downstream. Consideration will need to be given as to whether the existing survey extents cover this requirement. These survey extents may not cover this required area. The spatial extent may extend outside the current surveyed corridor if crossing points are close to the corridor boundary or the corridor itself shifts. If this is the case, further surveys will be required to cover the full survey area.

The Burn of Baillie in the Forss catchment could not be surveyed due to landowner restrictions.

The detailed surveys were undertaken later than optimal, and some sections on some of the burns could not be surveyed due to overgrown vegetation.

4.2. Fish habitat survey findings

Forss catchment

For the purposes of this process, the Forss catchment is considered to be accessible to migratory salmonids. However, river and sea lamprey are highly unlikely to pass the Forss Falls. Eel may be able to climb using moss and macrophytes on the wetted margins of the fall. The data from NEPS and the salmonid distribution map on the MSS portal indicate that salmon are present within the Project area for this catchment. Discussion with the regulator during this EIA process suggests that salmon are in significant decline within this catchment.

Based on the current defined Project area (see Figure 1.2), 7.8 km of the Forss Water and three of its tributaries, Hallam Burn, Burn of Baillie and Burn of Brimstone, fall within the potential cable corridor.

The upstream extent of the survey area for Forss Water has limited areas recorded as suitable for salmonid spawning. However, as the river continues its course downstream, spawning habitat was recorded throughout the survey area, with potential juvenile lamprey habitat recorded in the lower sections of the river. In addition, habitats are available for juvenile and adult salmonids and eel.

Of the three tributaries, Burn of Brimstone was dry and therefore unsuitable for fish and can be scoped out. The Burn of Baillie could not be surveyed due to access restrictions, and it should be assumed that fish could use it. Hallam Burn is a highly modified burn in poor condition with extensive silt and algae observed during the July survey; however, spawning and juvenile lamprey habitat were identified in the lower reaches near the confluence with the Forss Water. Site conditions may be sufficient to support healthy salmonid reproduction during colder wetter months.

Until the crossing points are finalised, it is difficult to identify the exact receptors that will be relevant to each site. However, it is clear that the Forss and its tributaries, apart from the Burn of Brimside, are likely to host all life history stages of brown trout, sea trout and Atlantic salmon, European eel and river lamprey. Therefore, it should be considered that works have to potential to impact these species,

and suitable mitigation will be required to ensure spawning activities are not impeded. Mitigation will also be needed to ensure the unhindered passage of adult fish upstream and juvenile fish downstream, particularly salmonid smolts. Lamprey will broadly use similar spawning habitat to salmonids, so protection of the latter will extend to lamprey species.

Thurso catchment

The Thurso catchment is accessible to migratory salmonids. The data from NEPS and the salmonid distribution map on the MSS portal indicate that salmon are present within the Project area for this catchment and clustered but abundant spawning habitat was recorded throughout during the walkover surveys. Based on the current defined Project area (see Figure 1.2), 4.5 km of the River Thurso and five of its tributaries, Carnavagry Burn, Sour Burn, Calder Burn, Burn of Halkirk and Burn of Achanarras, fall within the potential cable corridor.

Therefore, as with the Forss catchment, until the crossing points are finalised, it is difficult to determine the exact impacts on each of the watercourses in these catchments. However, the River Thurso and its tributaries are likely to host all life history stages of brown trout, sea trout and Atlantic salmon. European eel and all three species of lamprey may be present, particularly in the lower reaches. Therefore, it should be considered that works have to potential to impact these species, and suitable mitigation will be required to ensure potential impacts on fish are reduced or removed, for all life history stages of the species identified as receptors here.

4.3. Next steps

This report clearly identifies the presence of habitat suitable to support the continued presence of Atlantic salmon, sea trout/brown trout, lampreys and eel. Therefore, all species should be included in EIA assessment and mitigation. Final, site-based, mitigation will require specific assessments once those areas are defined as the method of crossing is a key factor in the mitigation to be designed, post consent. This site-specific mitigation will require a survey of 100 m above (upstream) and 500 m below (downstream) the crossing location. These surveys should be carried out between February and May to avoid channel and riparian vegetation obscuring important features.

A competent fish ecologist should review all designs to ensure no legacy effects, particularly in relation to the presence of new barriers, or barriers that could evolve, following construction.

Consultation with the statutory advisors has determined the requirement for monitoring to ensure the receptors remain unimpacted by the Project. This will be implemented via an Aquatic Monitoring Plan, and it will ensure the receptors remain unimpacted by the Project. Once the final Project infrastructure and cable routing is confirmed during detailed design (post consent), the Aquatic Monitoring Plan will be developed, approved and implemented based on consultation with relevant consultees.

Conclusion

- At the catchment scale, no native species can be scoped out of the EIA;
- For the Forss Water, river and sea lamprey can be scoped out above the Falls of Forss, but pass-down effects should be recognised;
- The Burn of Brimstone can be excluded from further assessment unless consistent flow is returned to the burn;
- All receptors should be included for the Thurso and tributaries; and
- Once specific crossing locations have been identified, and if these locations are outside the spatial extent of the detailed survey presented here, they will require further post-consent survey prior to the production of the Construction Method Statements (CMSs).

5. References

Buffington, J.M. & Montgomery, D.R. (2013). Geomorphic classification of rivers. In: '*Shroder J, Wohl E (eds) Treatise on geomorphology, Fluvial geomorphology vol 9'*. Academic Press, San Diego, pp 730–767.

Department for Environment, Food and Rural Affairs (DEFRA) (2010). Eel Management plans for the United Kingdom: Scotland River Basin District. Department for Environment, Food and Rural Affairs Commissioned Report.

Environment Agency (1997). Restoration of riverine salmon habitat. *EA Fisheries Technical Manual 4*. EA Bristol. Available online at: https://www.apemltd.com/wp-content/uploads/2016/08/Restoration-of-Riverine-Salmon-Habitats-A-Guidance-Manual.pdf [Accessed 20/09/22].

Hume, J.B., Adams, C.E., Mable, B. & Bean, C.W. (2013). Post-zygotic hybrid viability in sympatric species pairs: a case study from European lampreys. *Biological Journal of the Linnean Society*. 108,378-383.

Hume, J.B. (2017). A review of the geographic distribution, status and conservation of Scotland's lampreys. *The Glasgow Naturalist*. 26,1-10.

Jacoby, D. & Gollock, M. (2014). *Anguilla anguilla*. The IUCN Red List of Threatened Species 2014. Available online at: https://www.iucnredlist.org/species/pdf/45833138 [Accessed 20/09/22].

Malcolm, I., Millidine, K., Jackson, F., Glover, R. & Fryer, R. (2020). The National Electrofishing Programme for Scotland (NEPS) 2019. *Scottish Marine and Freshwater Science*. 11, 1-57.

Maitland, P.S. (2003). Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature Commissioned Report.

Marine Scotland Science (MSS) (2021a). SEPA river barrier database. Available online at: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=1746 [Accessed 19/09/22].

MSS (2021b). National Electrofishing Programme for Scotland (NEPS) data app. Available online at: https://scotland.shinyapps.io/sg-national-electrofishing-programme-scotland/ [Accessed 19/09/22].

MSS (2022). Scottish Salmon Rivers. Available online at: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=843 [Accessed 19/09/22].

NatureScot (2020). The Scottish Biodiversity List. Available online at: https://www.nature.scot/doc/scottish-biodiversity-list [Accessed 21/09/22].

NatureScot (2022). NatureScot Sitelink map. Available online at: https://sitelink.nature.scot/map [Accessed 19/09/22].

Raven, P.J., Holmes, N.T.H., Dawson, F.H. & Everard, M. (1998). Quality Assessment using River Habitat Survey Data. *Aquatic Conservation Marine and Freshwater Ecosystems*. 8,477-499.

Scottish Environment Protection Agency (SEPA) (2022). SEPA Water Framework Directive. Available online at: https://www.sepa.org.uk/data-visualisation/water-environment-hub/ [Accessed 20/09/22].

Toland, M., Webster, K., McDermott, T., Murphy, P. & Hale, P. (2008). The River Hydromorphology Assessment Technique; A WFD compliant assessment method for Ireland. Northern Ireland Environment Agency Water Management Unit Commissioned Report.

Welton, J.S., Beaumont, W.R.C. & Ladle, M. (2001). Timing of migration and changes in age structure of Atlantic salmon, *Salmo salar* L., in the River Frome, a Dorset chalk stream, over a 24-year period. *Fisheries Management and Ecology*. 10,1365-2400.

Wright, R.M., Piper, A.T., Aarestrup, K., Azevedoe, J.M.N., Cowan, G., Don, A., Gollock, M., Ramallo, S.R., Velterop, R., Walker, A., Westerberg, H. & Righton, D. (2022). First direct evidence of adult European eels migrating to their breeding place in the Sargasso Sea. *Scientific Reports.* 12,1562-1568.

6. Abbreviations

Acronym	Definition
CMS	Construction Method Statements
DBA	Desk-Based Assessment
DEFRA	Department for Environment, Food and Rural Affairs
DSFB	District Salmon Fisheries Board
EIA	Environmental Impact Assessment
HBA	Habitat-Based Approach
IUCN	International Union for the Conservation of Nature
km	Kilometre
Ltd	Limited
LWD	Large Woody Debris
m	Metre
MSS	Marine Scotland Science
NEPS	National Electrofishing Programme Scotland
NMPi	National Marine Plan Interactive
OWPL	Offshore Wind Power Limited
PPP	Planning Permission in Principle
PSA	Potentially Sensitive Areas
RHAT	River Habitat Assessment Technique
RHS	River Habitat Survey
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SHET-L	Scottish Hydro Electric Transmission Limited
SPA	Special Protection Area
Spp.	Species (plural)
SSSI	Sites of Special Scientific Interest
WB	Waterbodies
WFD	Water Framework Directive

Appendix A - List of Habitat walkover features (Standard)

A1.1. Features recorded

Feature Class	Feature	Code	Type
Flow biotypes	Free Fall	Ff	Polygon
	Chaotic	Ch	Polygon
	Cascade	Ca	Polygon
	Backwater	Ba	Polygon
	Broken water	Bw	Polygon
	Rapid	Ra	Polygon
	Chute	Ch	Polygon
	Upwelling	Up	Polygon
	Riffle (0+ salmonid)	RIF	Polygon
	Run (<0+ salmonid)	Ru	Polygon
	Glide (<0+ salmonid)	Gl	Polygon
	Pool (adult, refuge)	Po	Polygon
	Impoundment	Imp	Polygon
	No perceptible flow	NPF	Polygon
	Exposed in-channel bedrock	BED	Polygon
	Dry channel	DRY	Polygon
In-channel features	Side Channel	SC	Polygon
	Side bar *	Sb	Polygon
	Mid channel bar*	MCB	Polygon
	Point Bar*	Pb	Polygon
	Island	Mi	Polygon
	Debris dams	Dd	Polygon
	Large woody debris	LWD	Point
	Ford	Fo	Polygon
	Culvert	Cu	Polygon

Feature Class	Feature	Code	Type
	Erratic boulders	Bo	Point
	Lithophilic spawning habitat	X	Point
Modifications	Weir	W	Point
	Ford	Fo	Polygon
	Culvert	Cu	Polygon
	Channel reinforcement	Ri	Polygon
	Hard bank mods	HMB	Line
	Soft bank mods**	SMB	Line
Riparian	Overhanging trees	OH	Line
	Tunnel vegetation	TV	Line
	Bank erosion	Er	Line
	Poaching	Pc	Line
	Overhanging bank	OB	Line
Pollution inputs	Diffuse pollution source	DP	Polygon
	Diffuse pollution input	DP	Point/Line

A1.2. Data recorded on the composition of bar forms

Feature class	Composition	Code
Substrates/ bar form	Boulder	Bo
	Cobble	Co
	Gravel/pebble	GP
	Sand/silt	Sa/Si
	Vegetated	Veg

A1.3. Data recorded on form of modifications and composition

Feature Class	Composition	Code
Hard bank modification (Reinforcement)	Brick (Br)	Br
	Concrete (Cc)	Cc
	Stone (St)	St
	Riprap	RR
	Gabion	Ga
	Tipped Debris	TD
Soft Bank Modifications	Realigned	Ra
	Resectioned	Rs
	Embankment	Emb
	Over widened	OW

Appendix B – Habitat map book; Forss Water

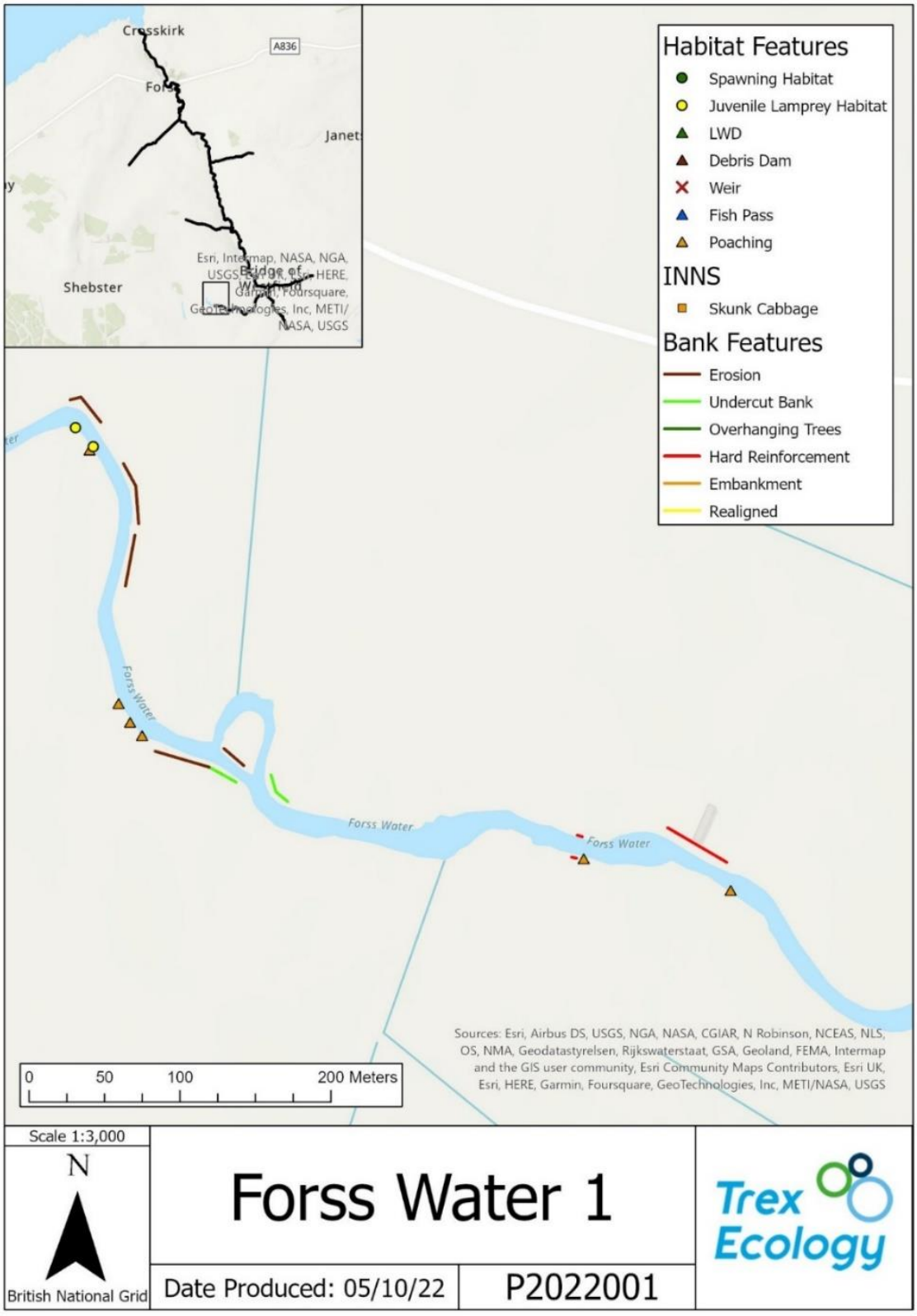
As the reconnaissance and detailed habitat walkover were carried out during different phases of the cable route refinement (See Section 1.3), two distinct map books have been produced. Section B1 presents the data from the reconnaissance walkover, while Section B2 presents the data from the detailed walkover.

B1 Forss Catchment Recon Walkovers

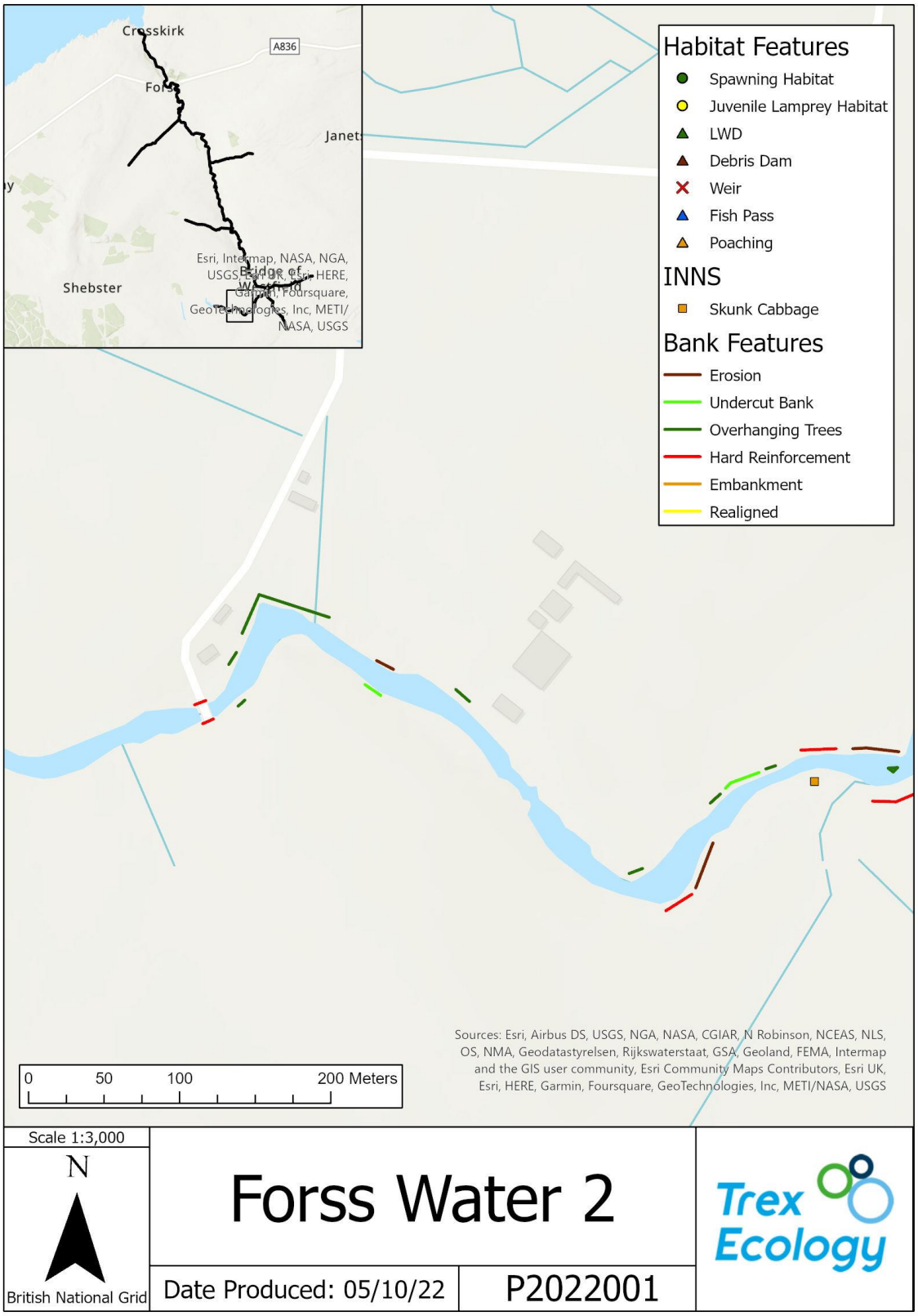
Presented in Appendix B1 are the results of the reconnaissance walkovers for the Forss Catchment.

B1.1 Forss Water

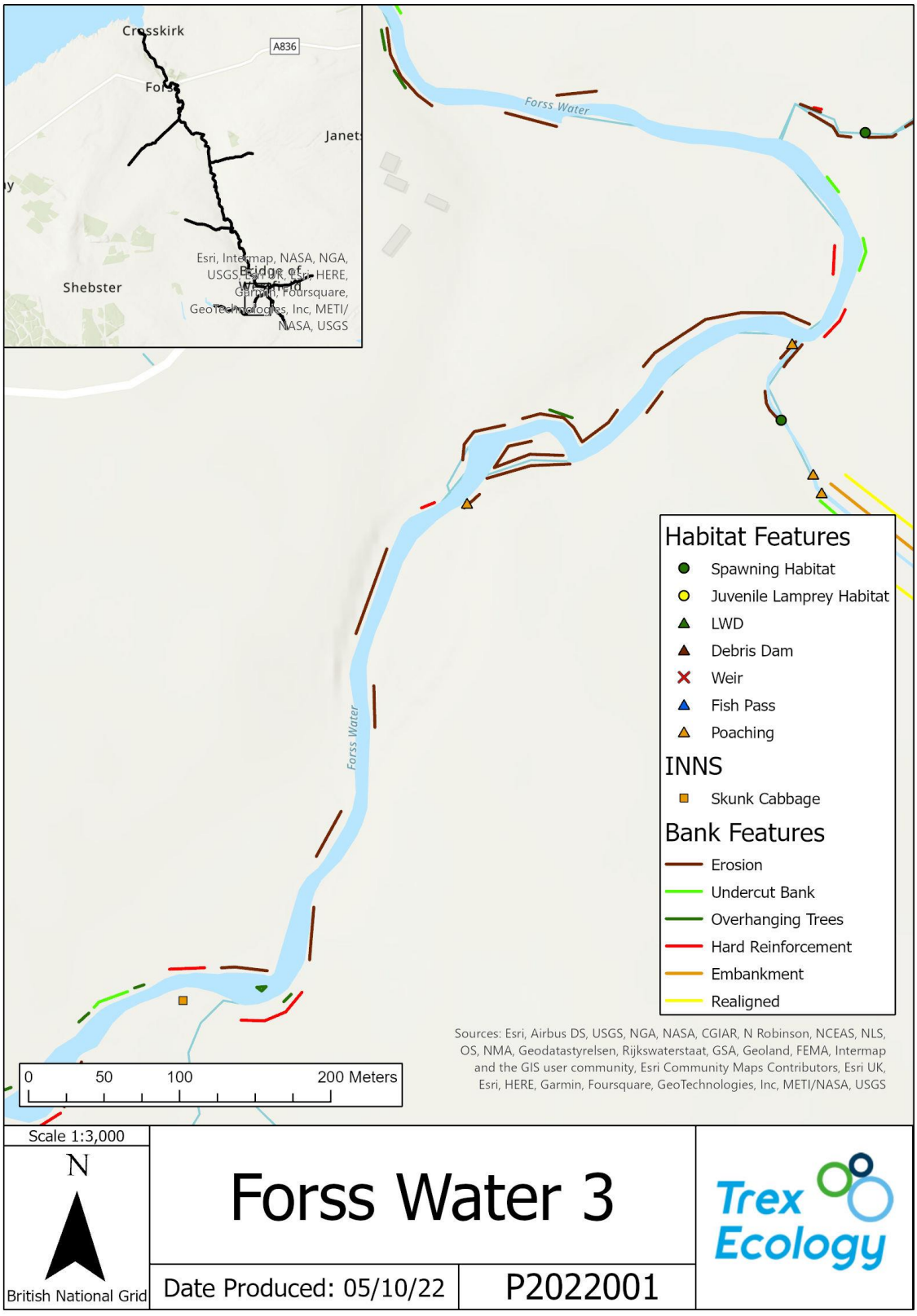
The maps for the Forss Water are set at a scale of 1:3,000.



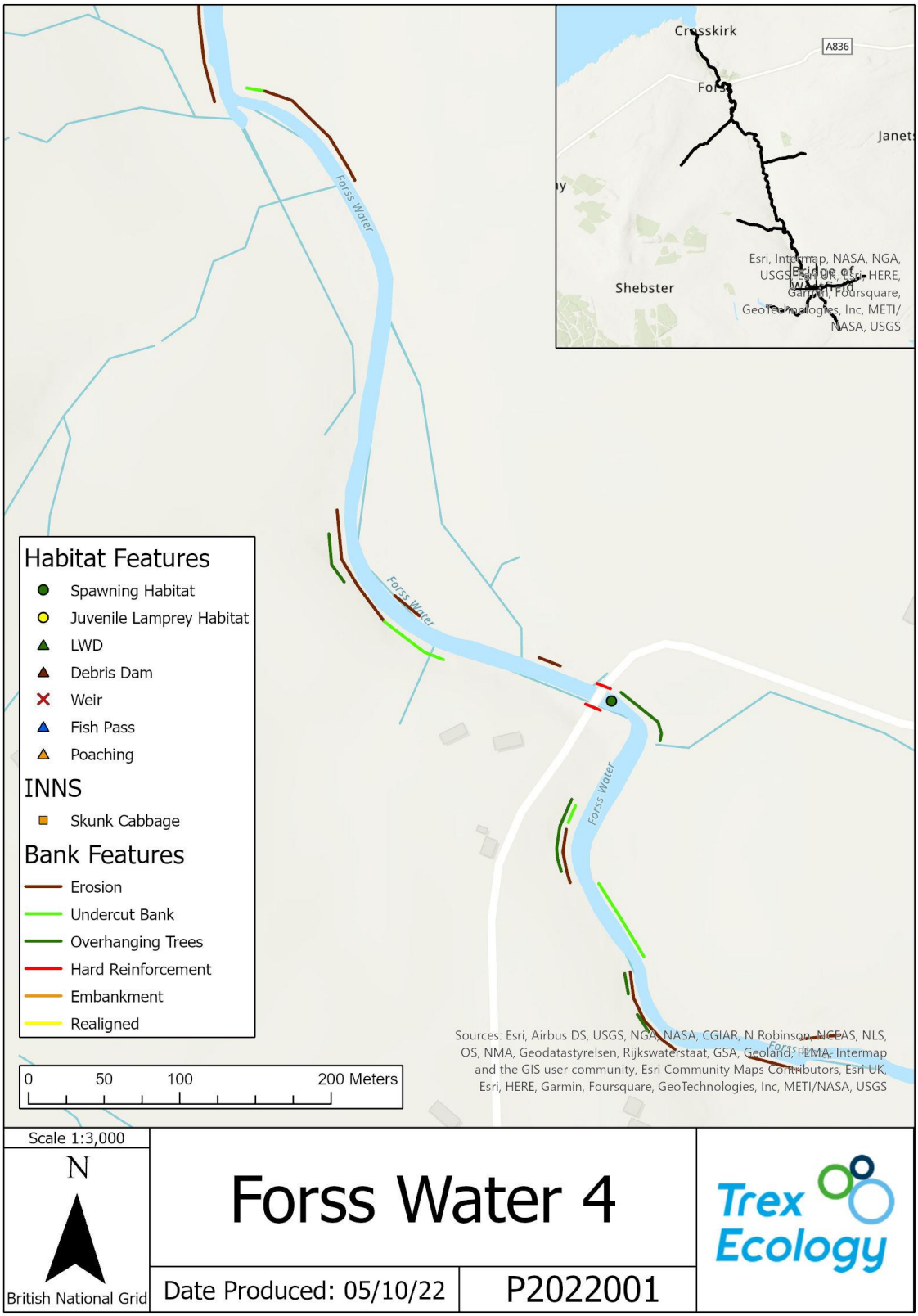
B1.1. Forss Water, rapid survey, map 1



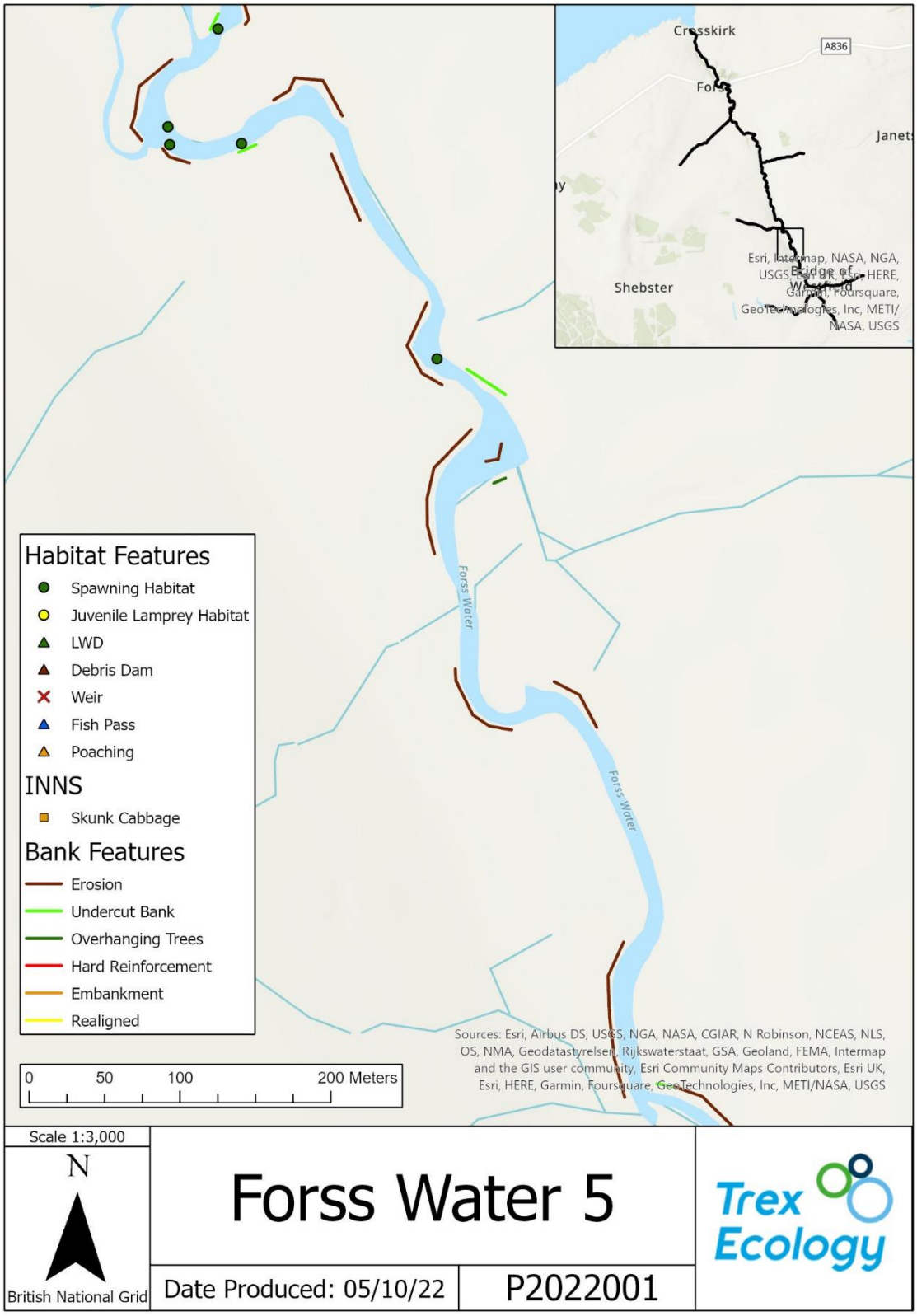
B1.2. Forss Water, rapid survey, map 2



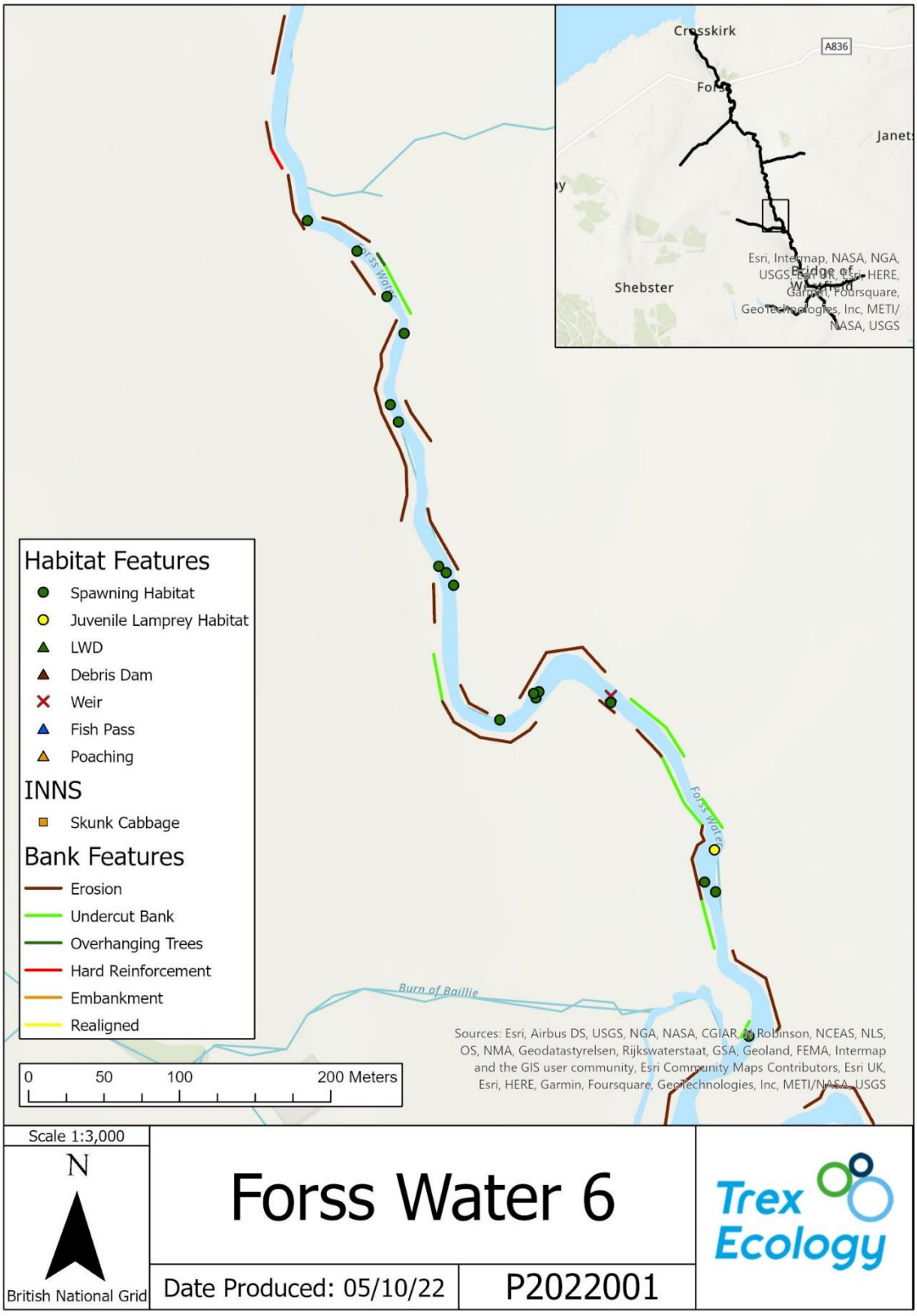
B1.3. Forss Water, rapid survey, map 3



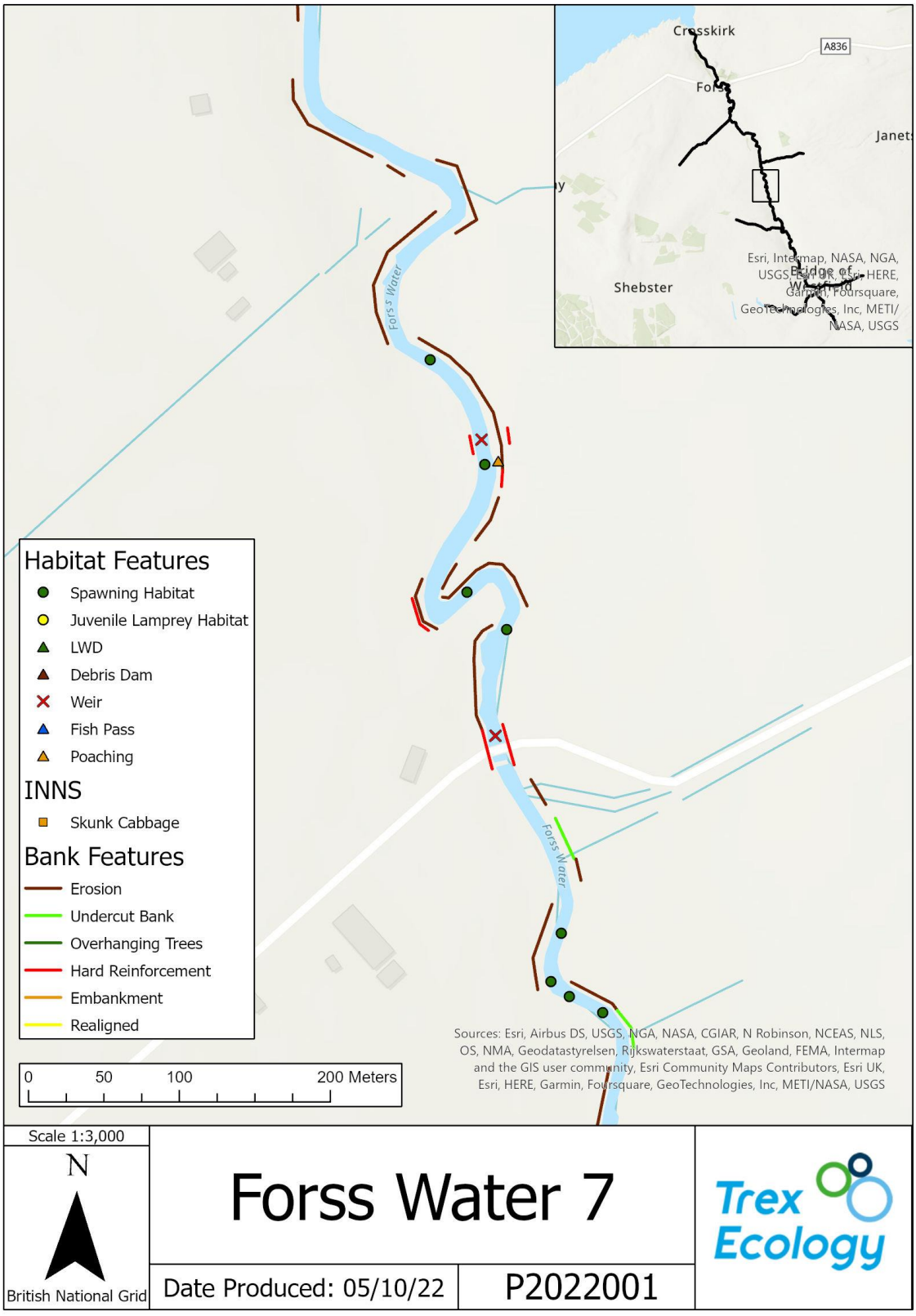
B1.4. Forss Water, rapid survey, map 4



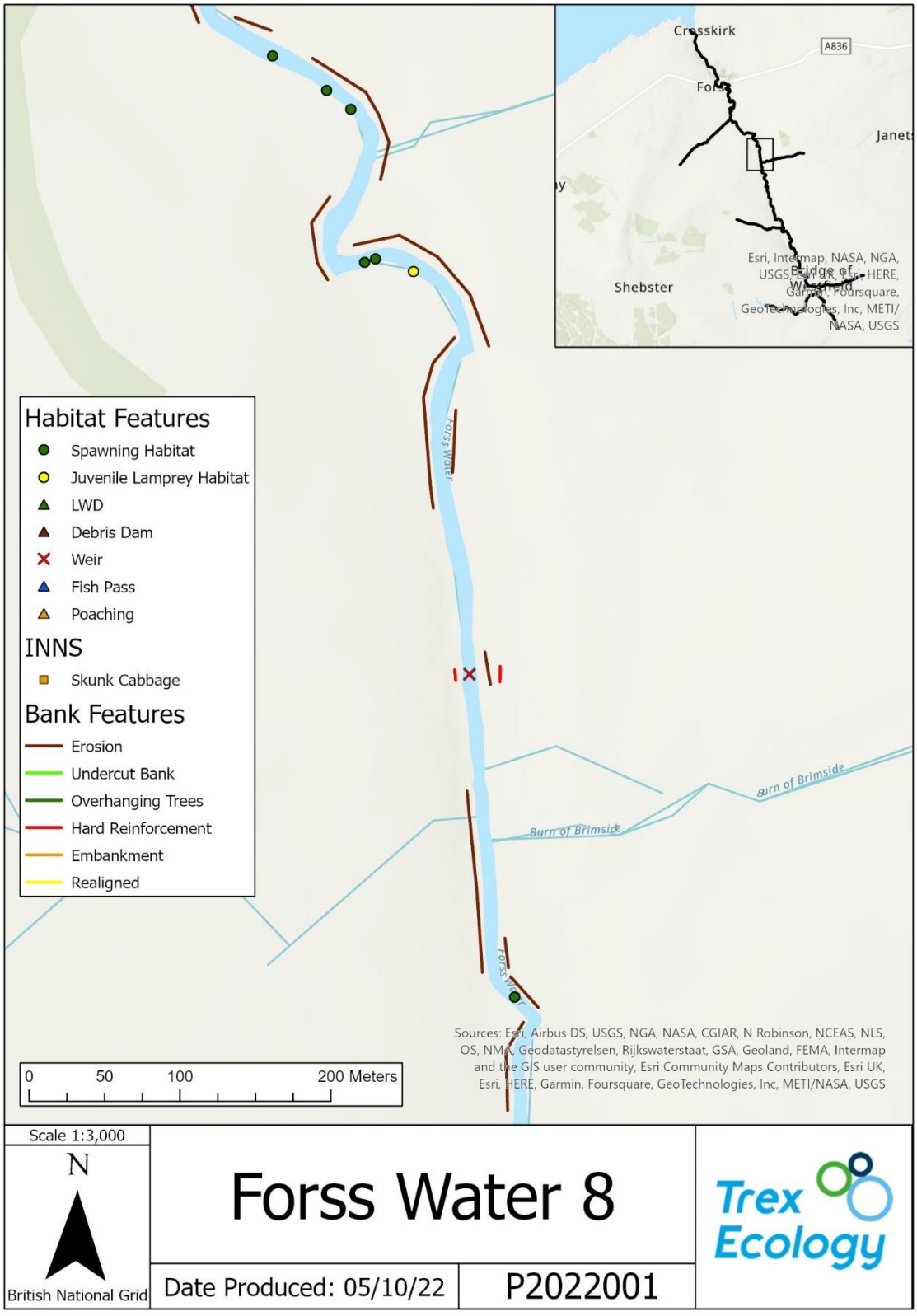
B1.5. Forss Water, rapid survey, map 5



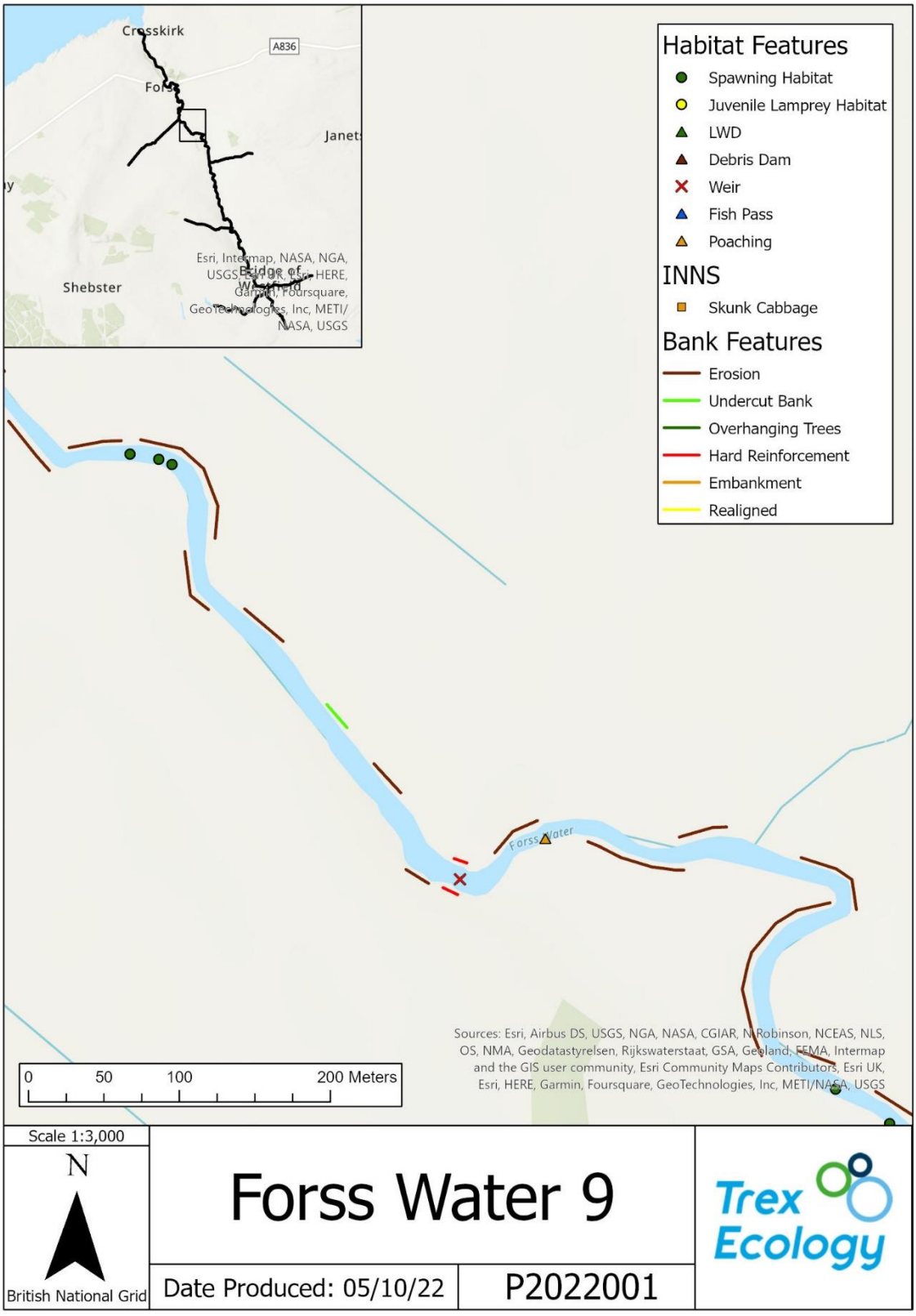
B1.6. Forss Water, rapid survey, map 6



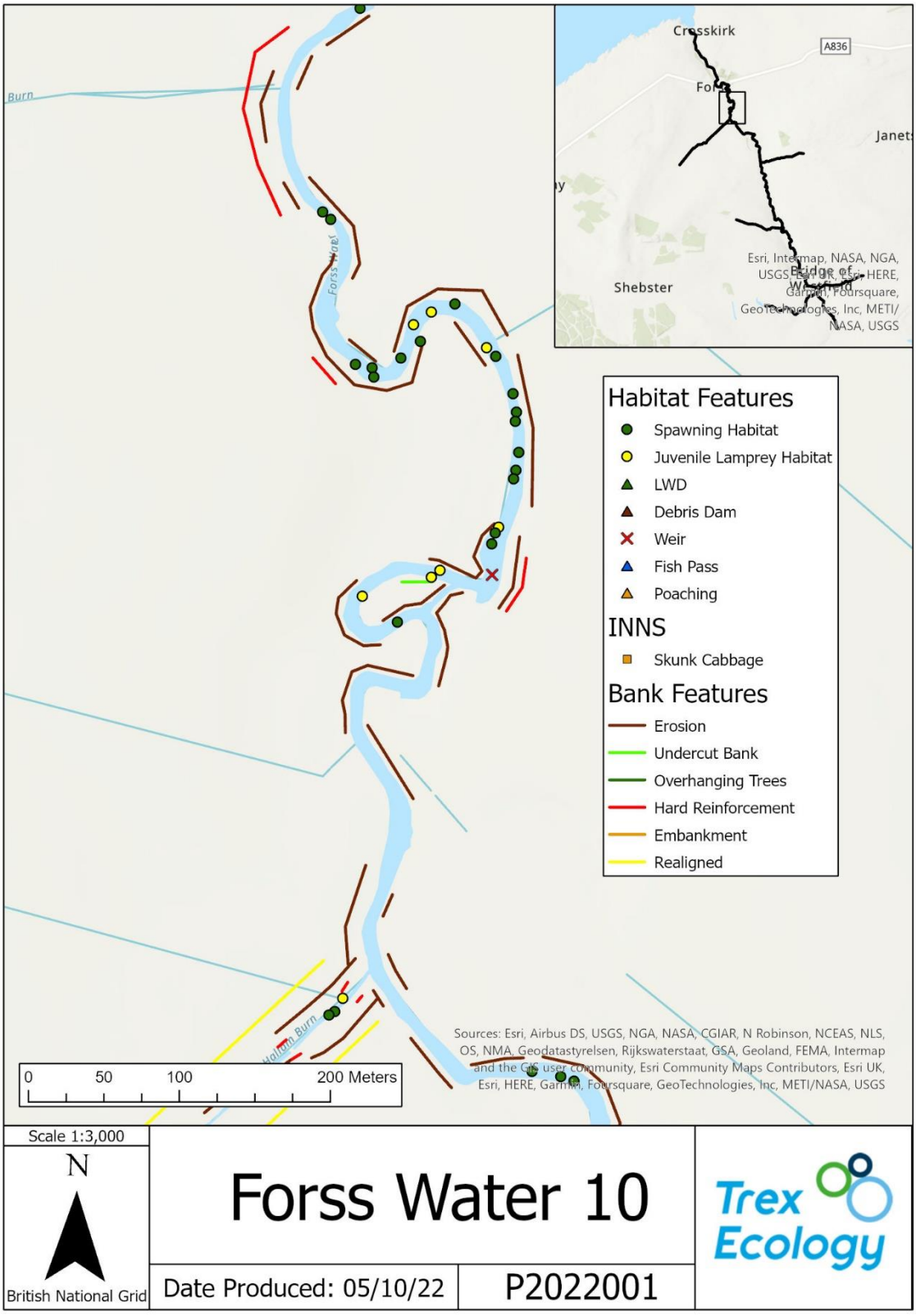
B1.7. Forss Water, rapid survey, map 7



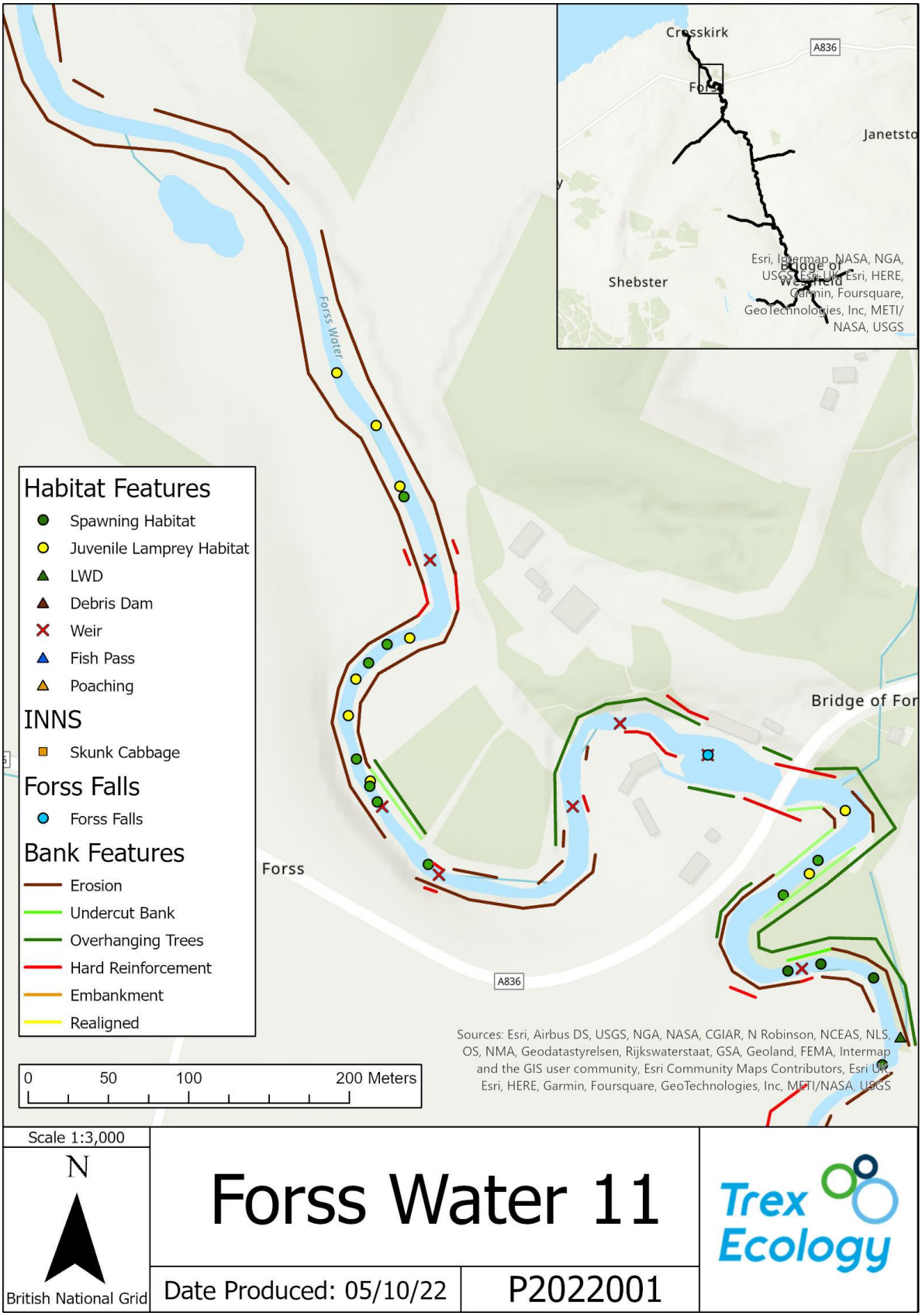
B1.8. Forss Water, rapid survey, map 8



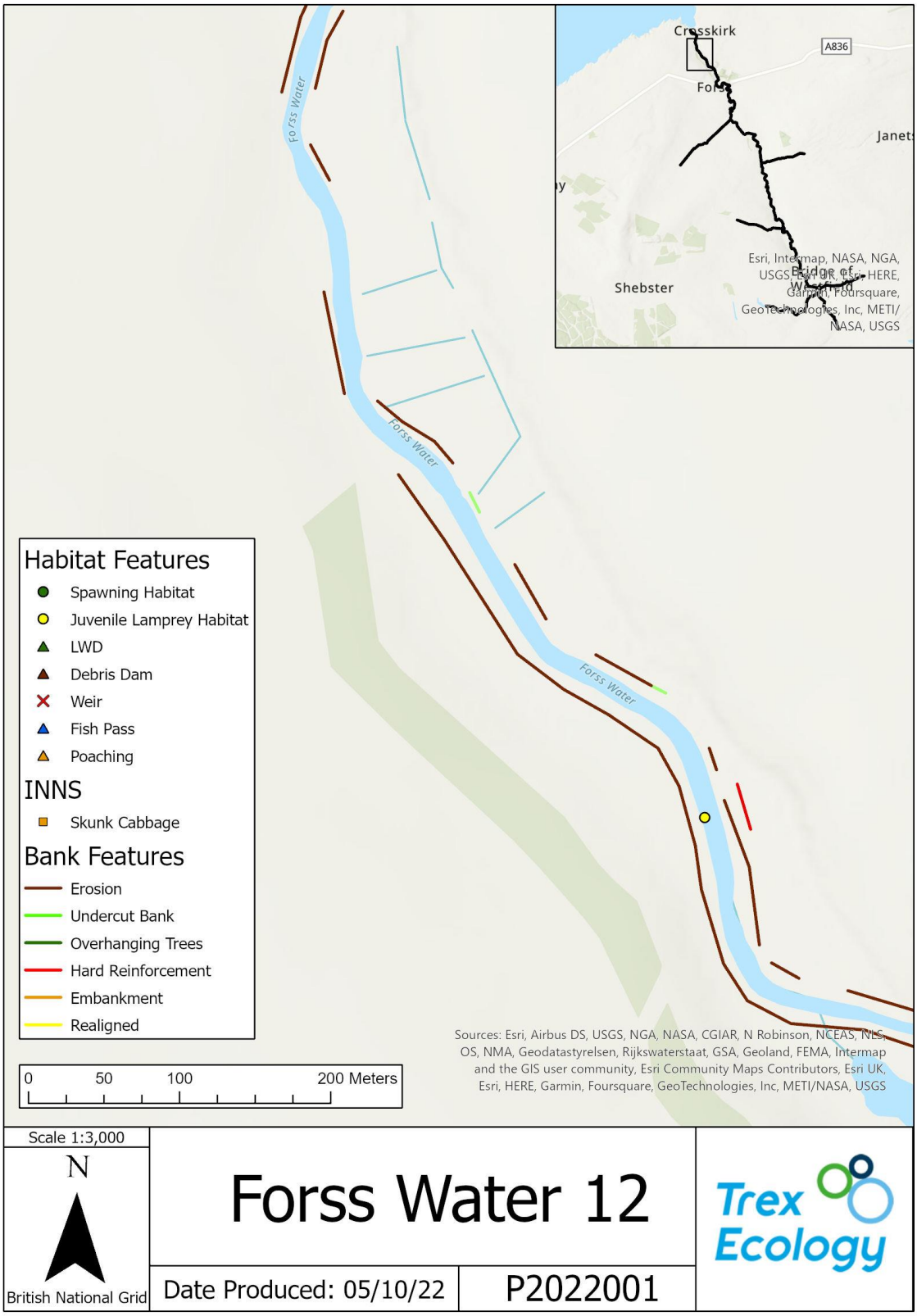
B1.9. Forss Water, rapid survey, map 9



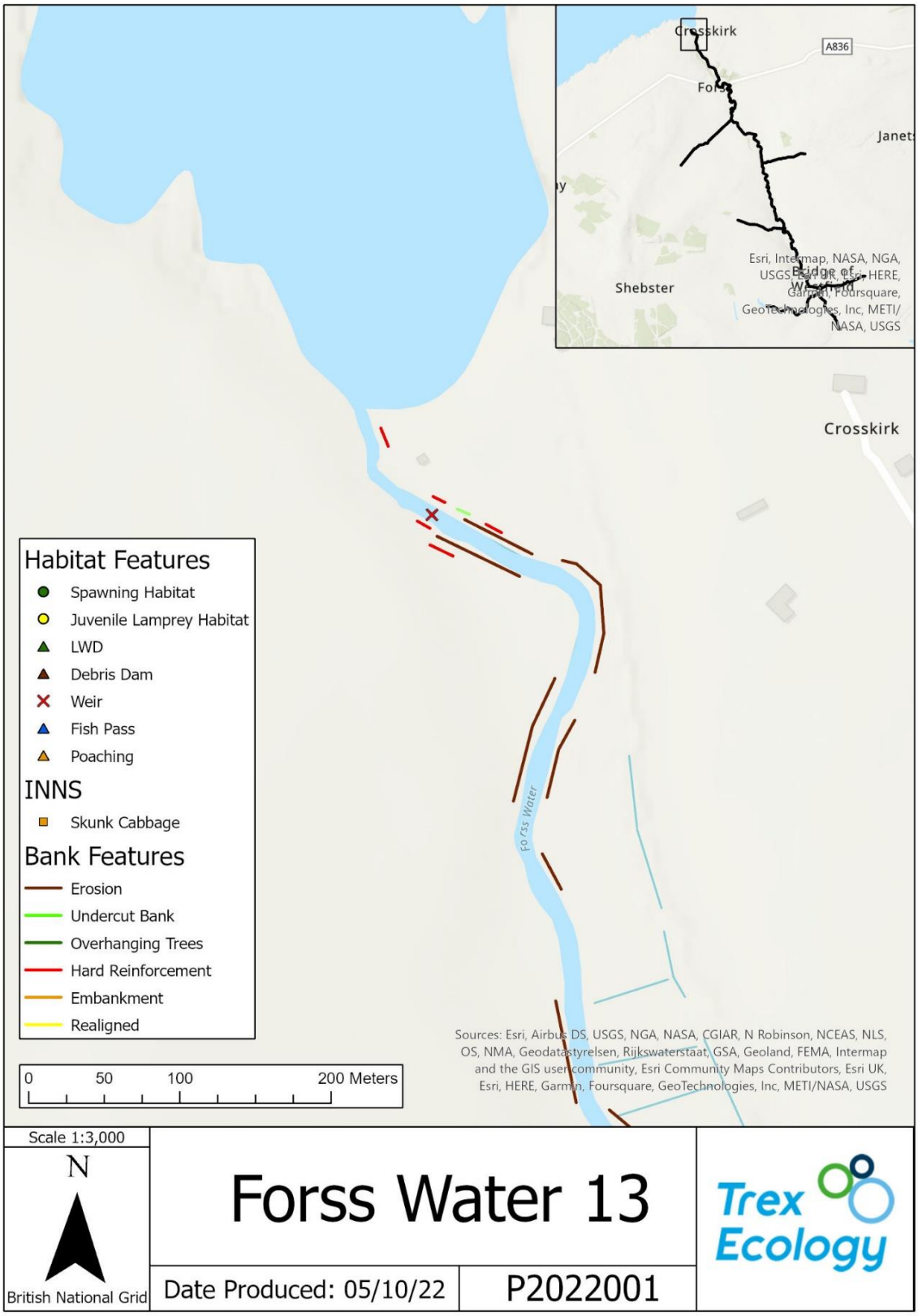
B1.10. Forss Water, rapid survey, map 10



B1.11. Forss Water, rapid survey, map 11



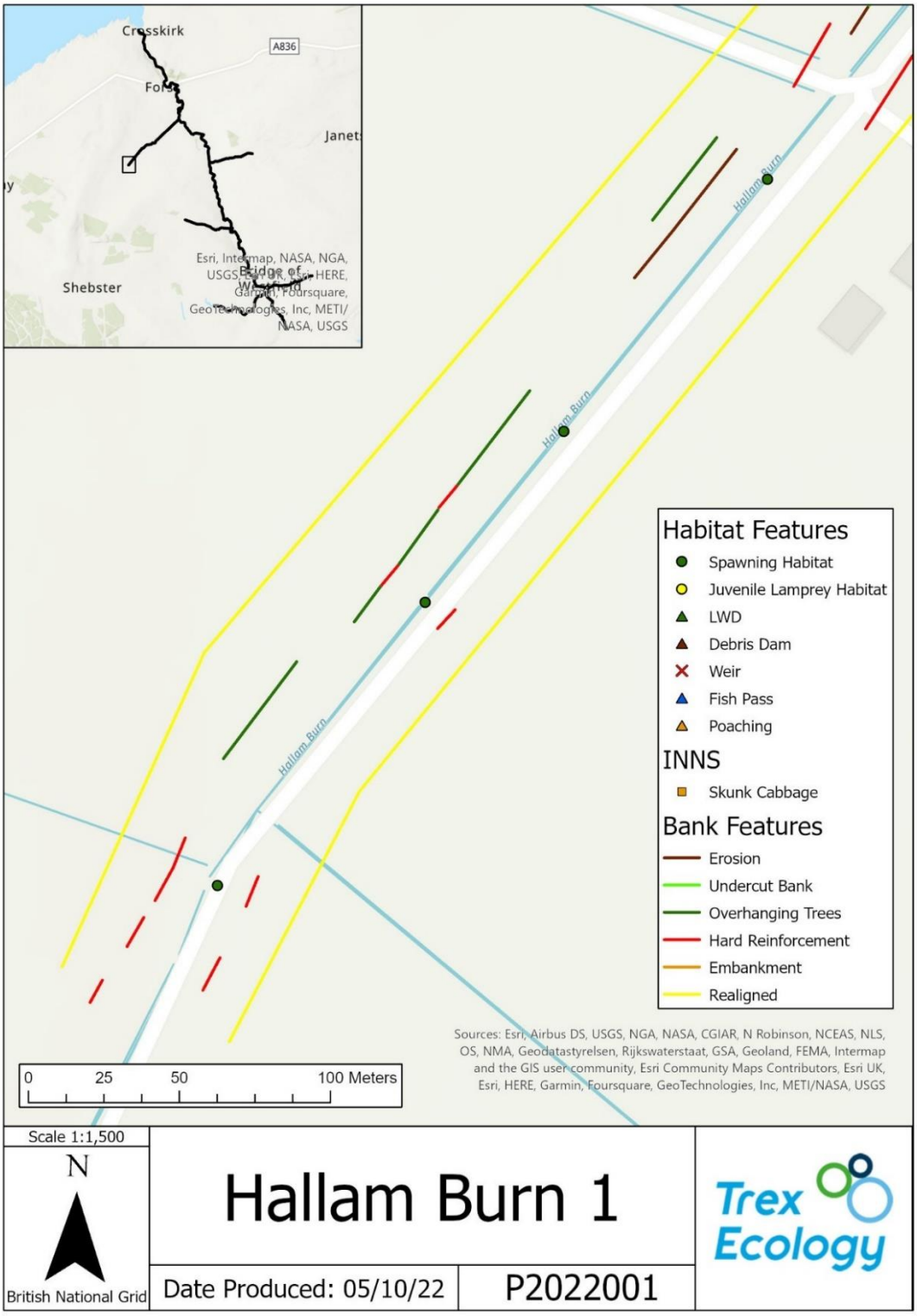
B1.12. Forss Water, rapid survey, map 12



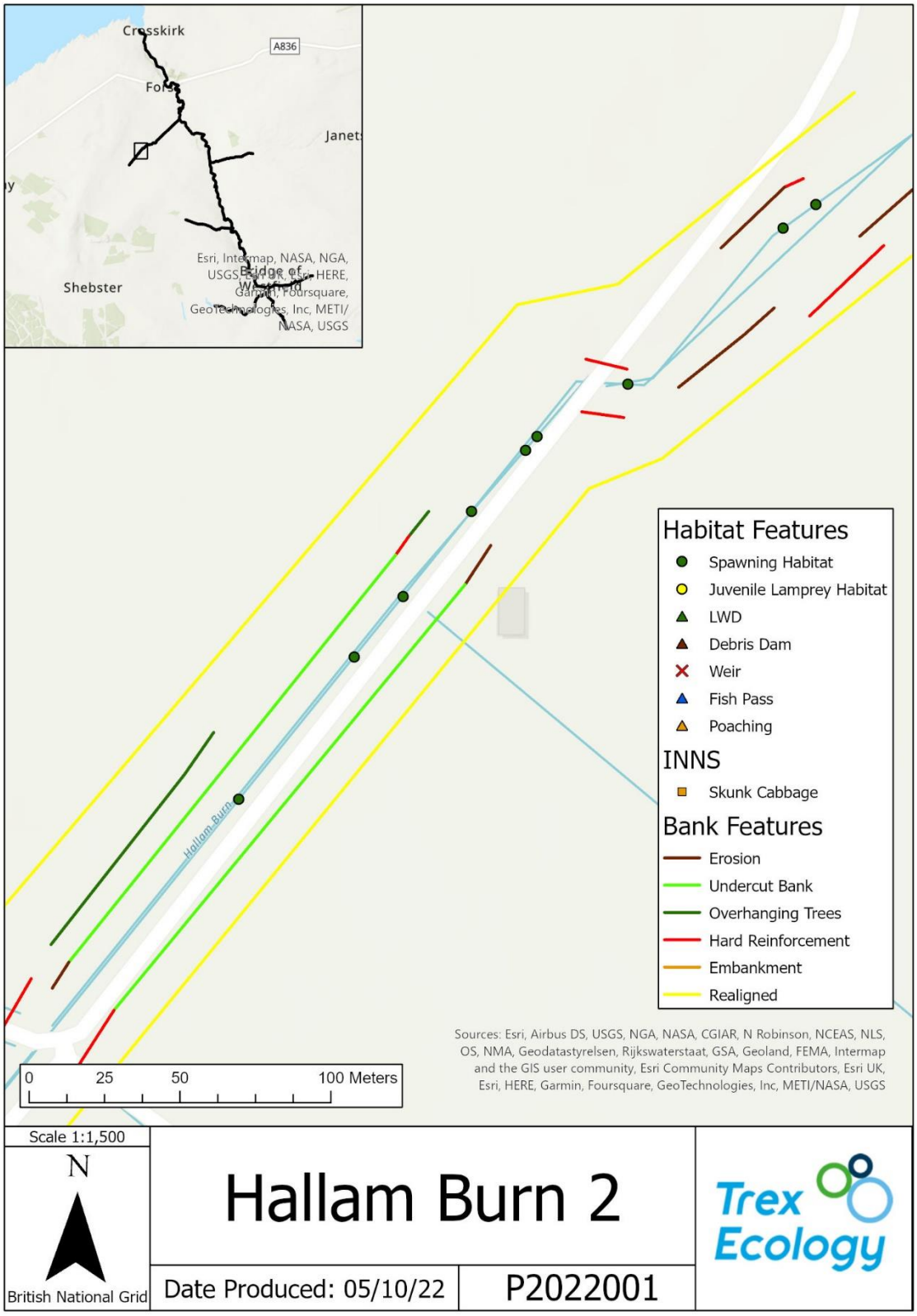
B1.13. Forss Water, rapid survey, map 13

B1.2 Hallam Burn

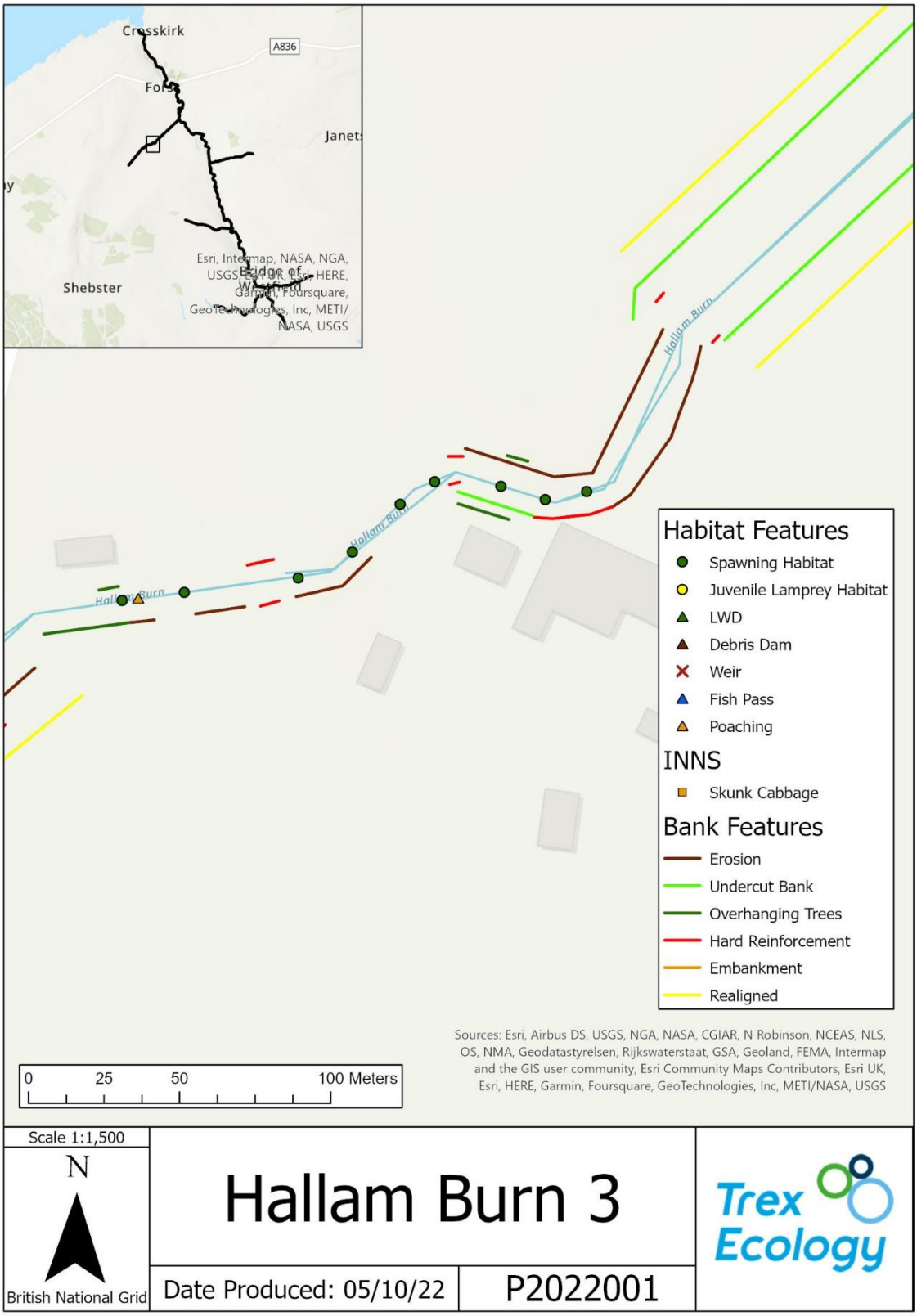
The maps for Hallam Burn are set at a scale of 1:1,500.



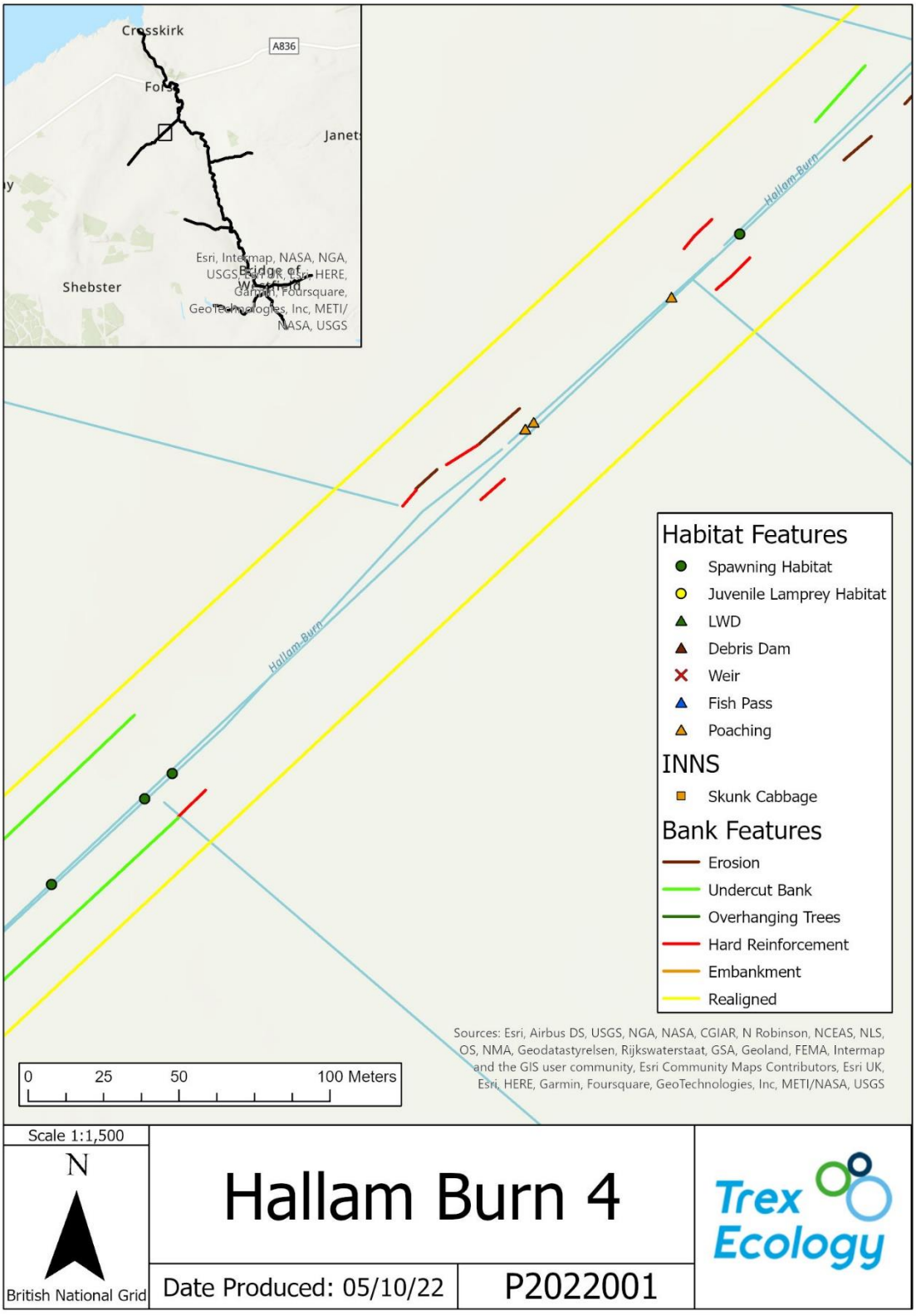
B1.14. Hallam Burn, rapid survey, map 1



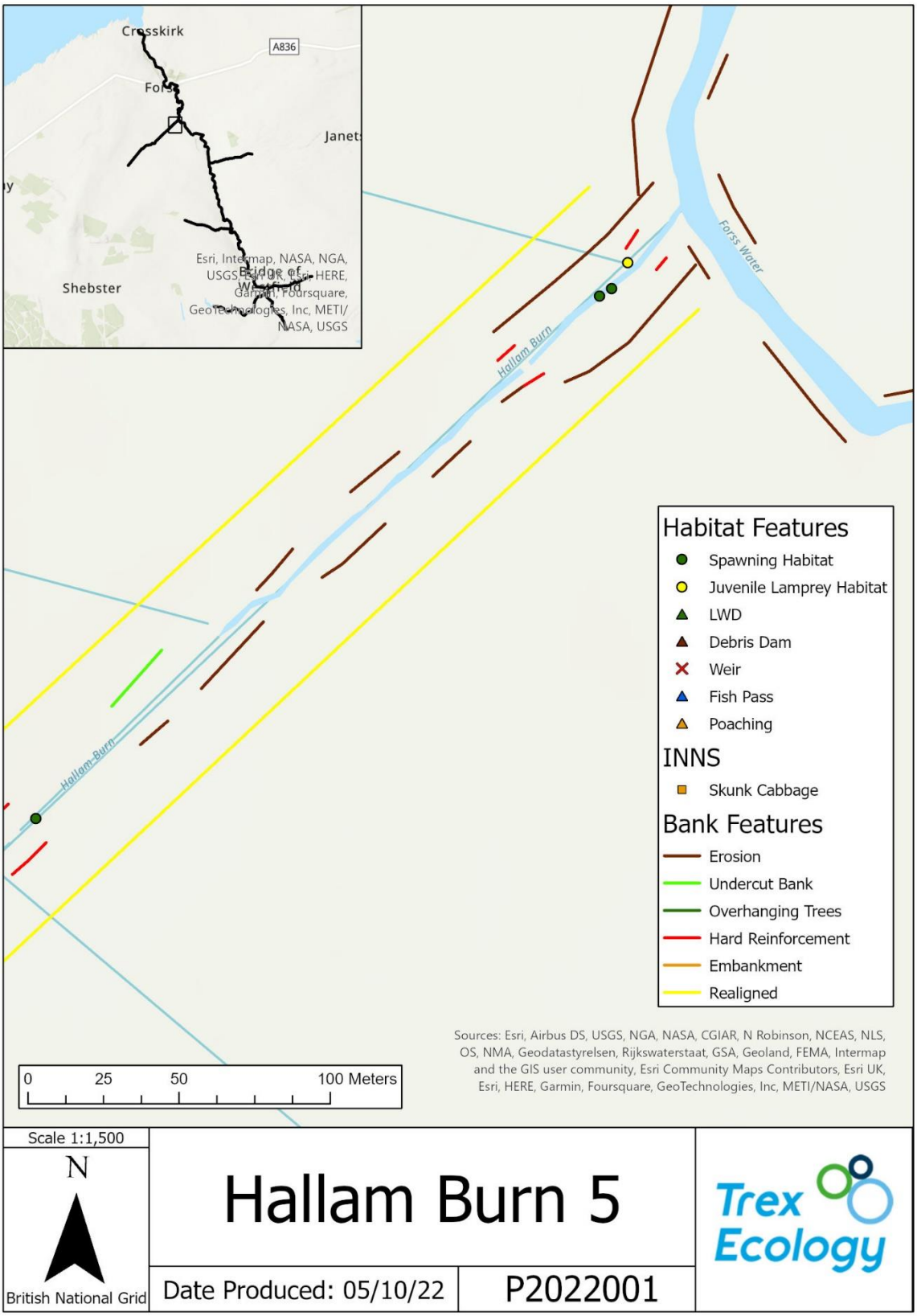
B1.15. Hallam Burn, rapid survey, map 2



B1.16. Hallam Burn, rapid survey, map 3



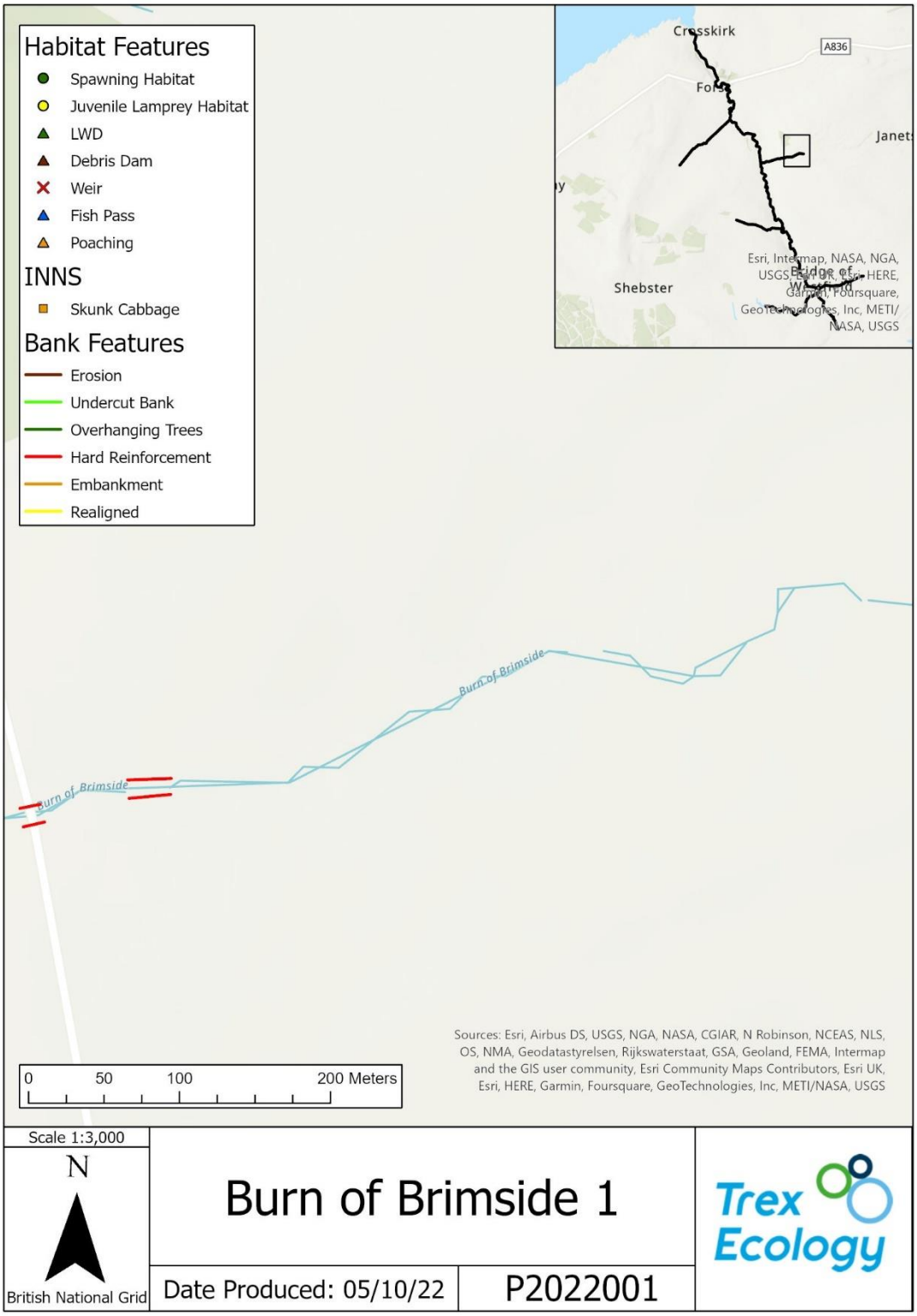
B1.17. Hallam Burn, rapid survey, map 4



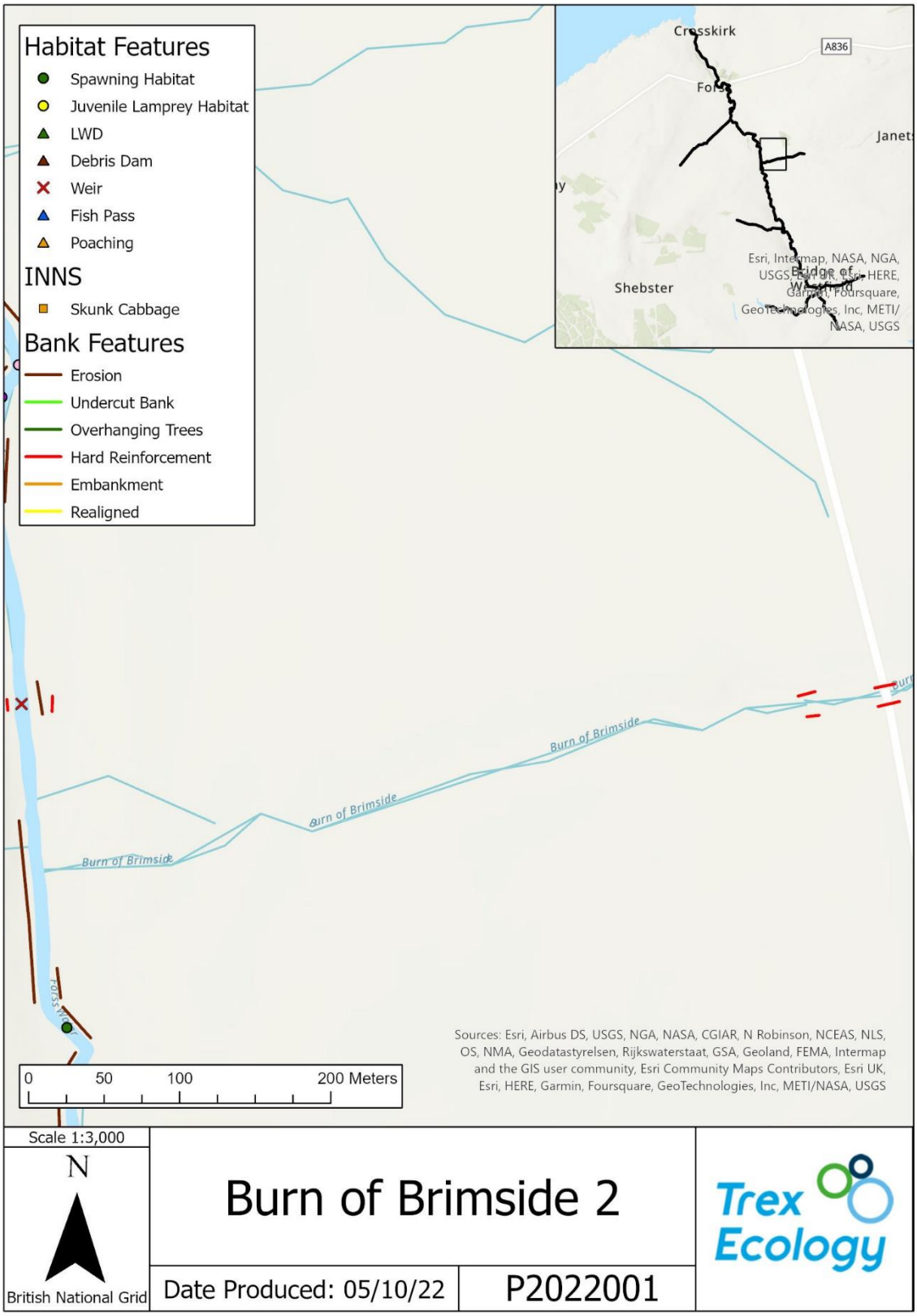
B1.18. Hallam Burn, rapid survey, map 5

B1.3 Burn of Brimside

The maps for Burn of Brimside are set at a scale of 1:3,000.



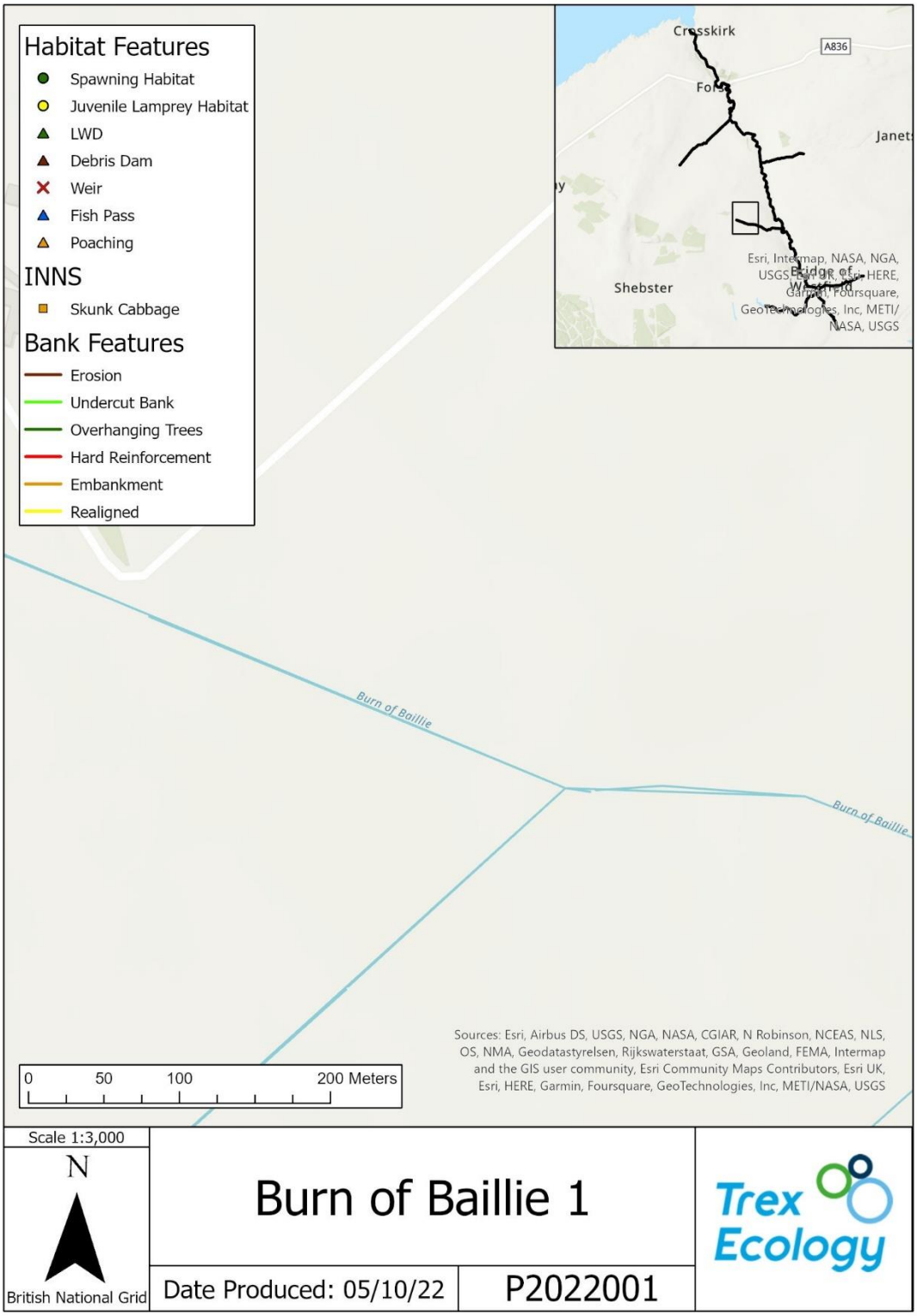
B1.19. Burn of Brimside, rapid survey, map 1



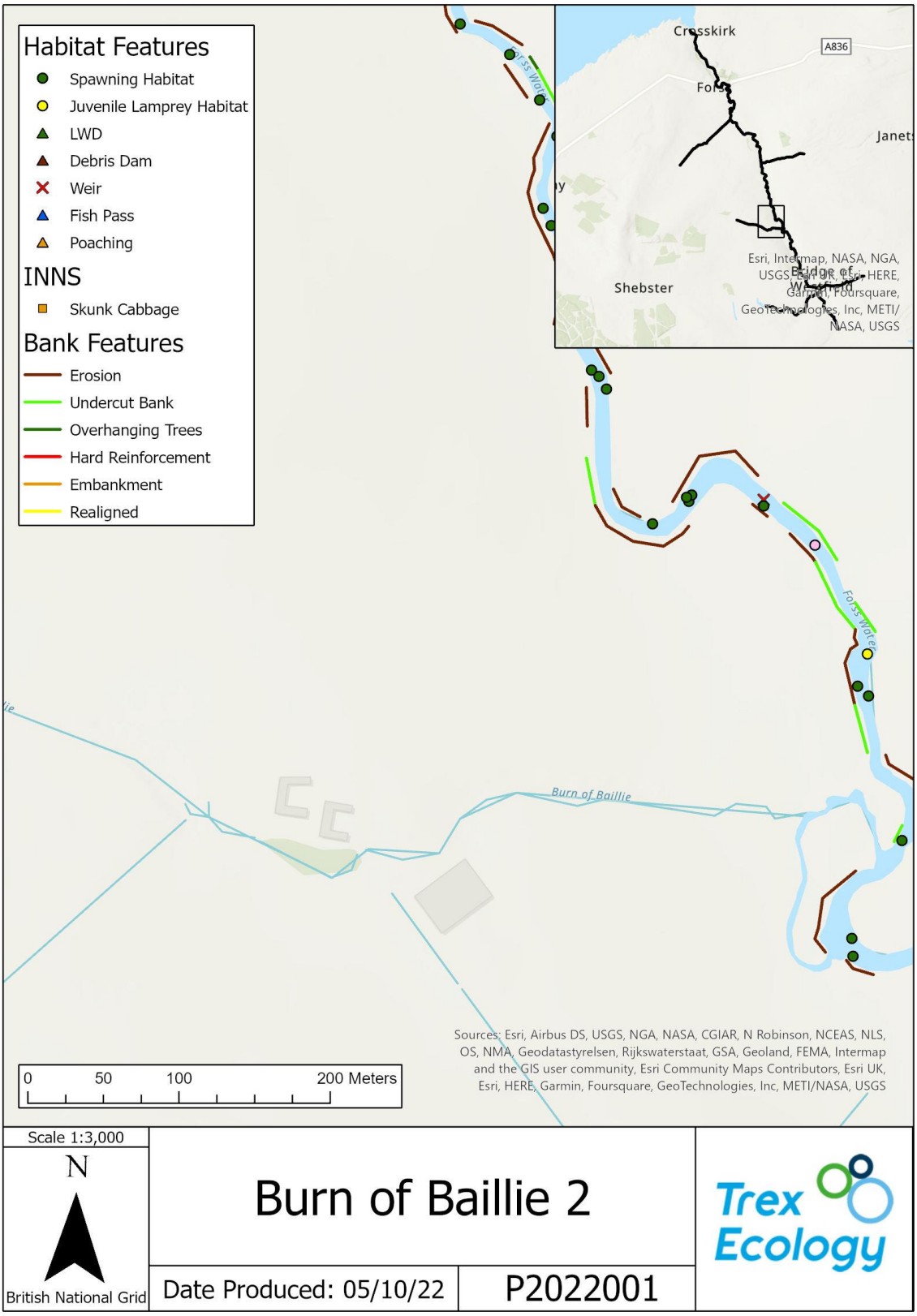
B1.20. Burn of Brimside, rapid survey, map 2

B1.4 Burn of Baillie

The maps for Burn of Baillie are set at a scale of 1:3,000.



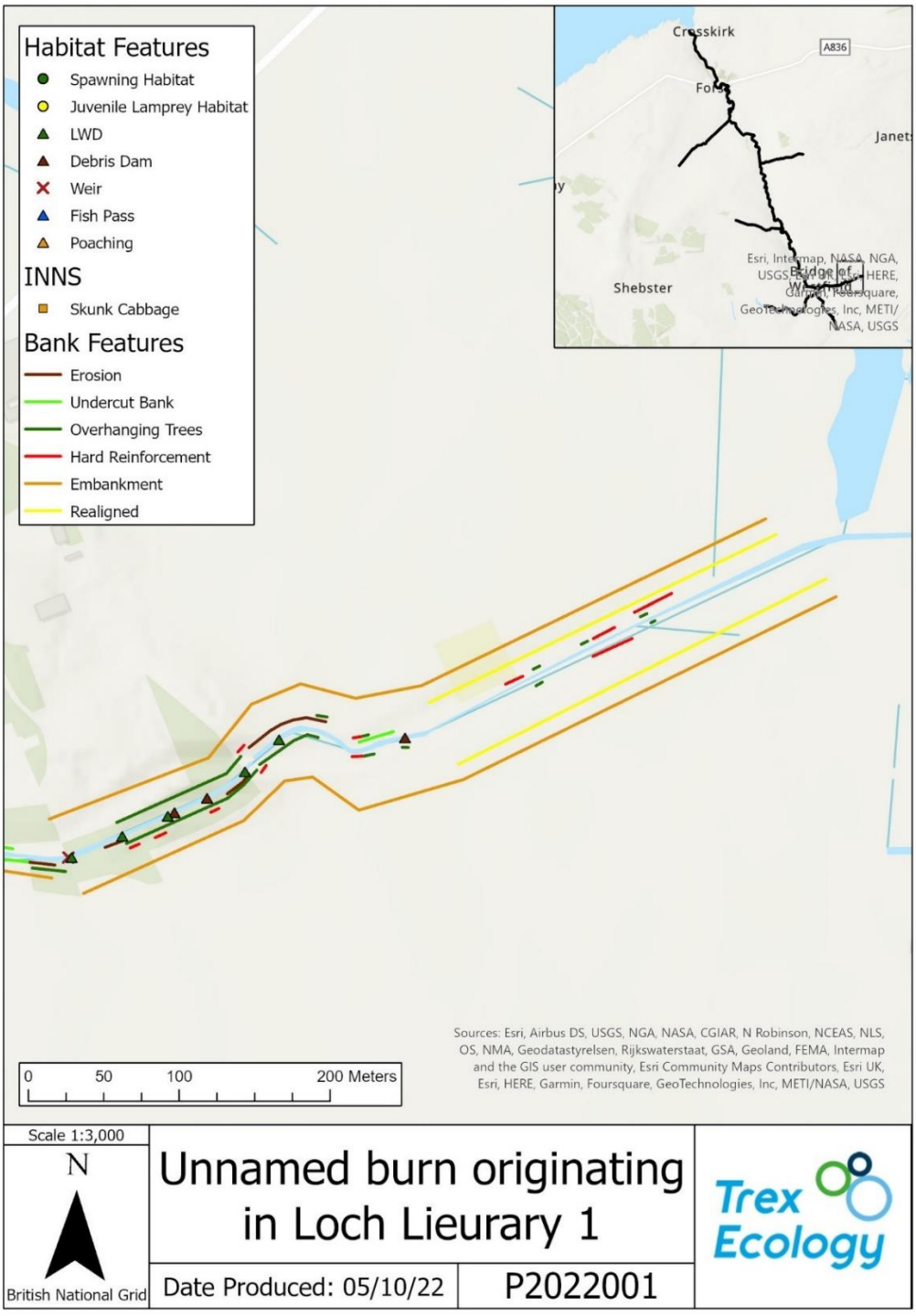
B1.21. Burn of Baillie, rapid survey, map 1



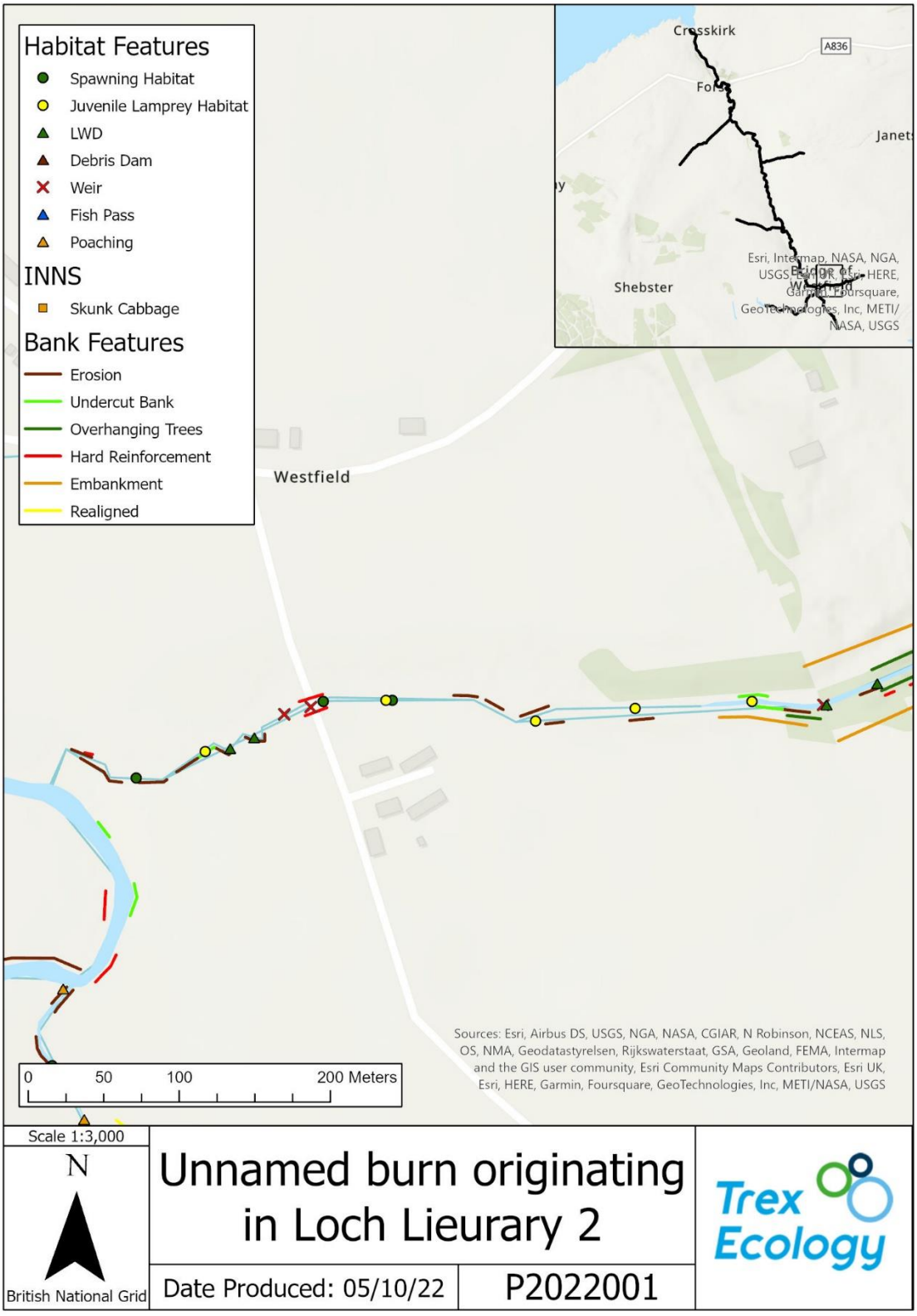
B1.22. Burn of Baillie, rapid survey, map 2

B1.5 Unnamed burn originating in Loch Lieurary Recon Walkovers

The maps for the unnamed burn originating in Loch Lieurary are set at a scale of 1:3,000.



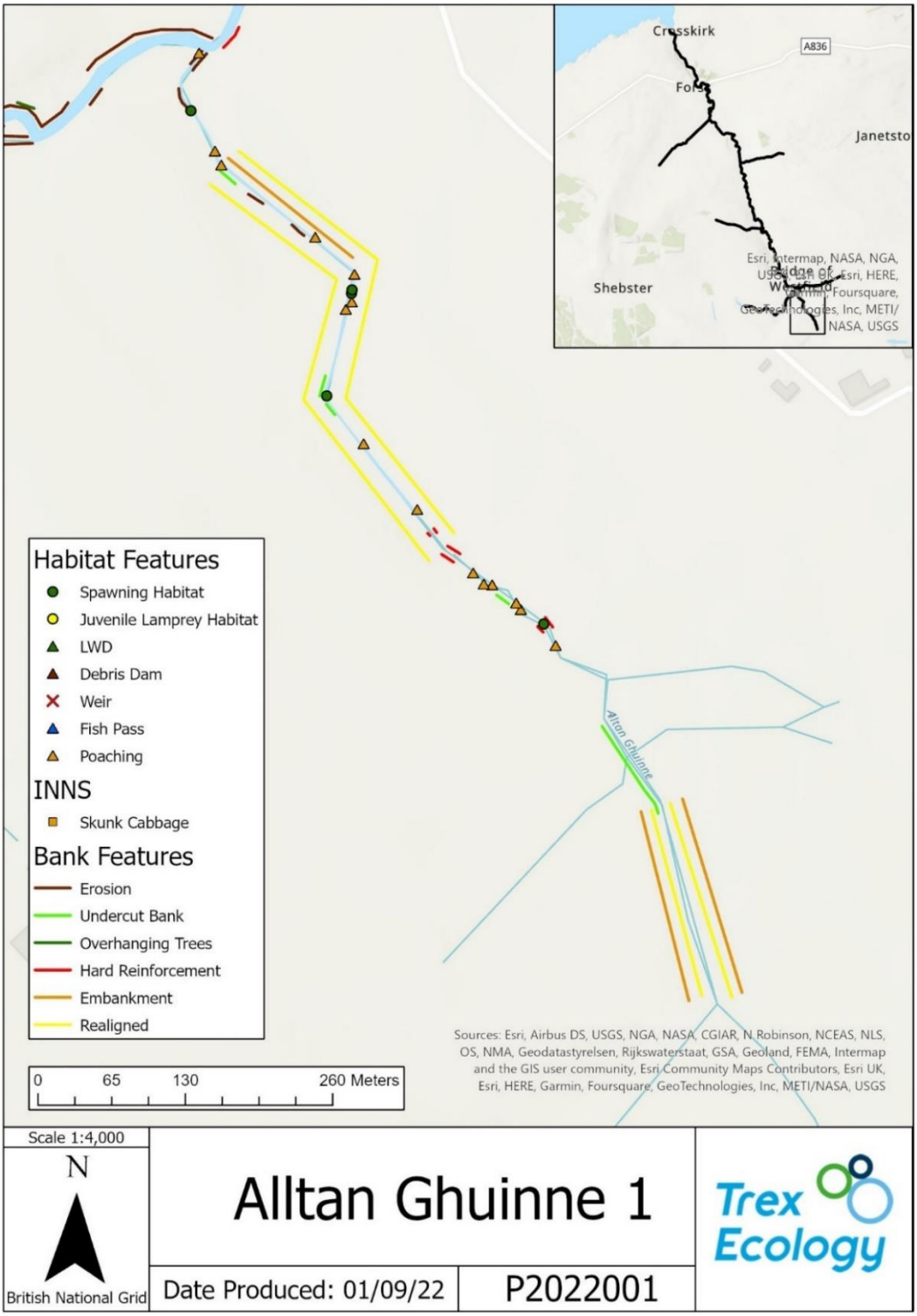
B1.23. Unnamed burn originating in Loch Lieurary, rapid survey, map 1



B1.24. Unnamed burn originating in Loch Lieurary, rapid survey, map 2

B1.6 Alltan Ghuinne Recon Walkovers

The maps for Alltan Ghuinne are set at a scale of 1:4,000.



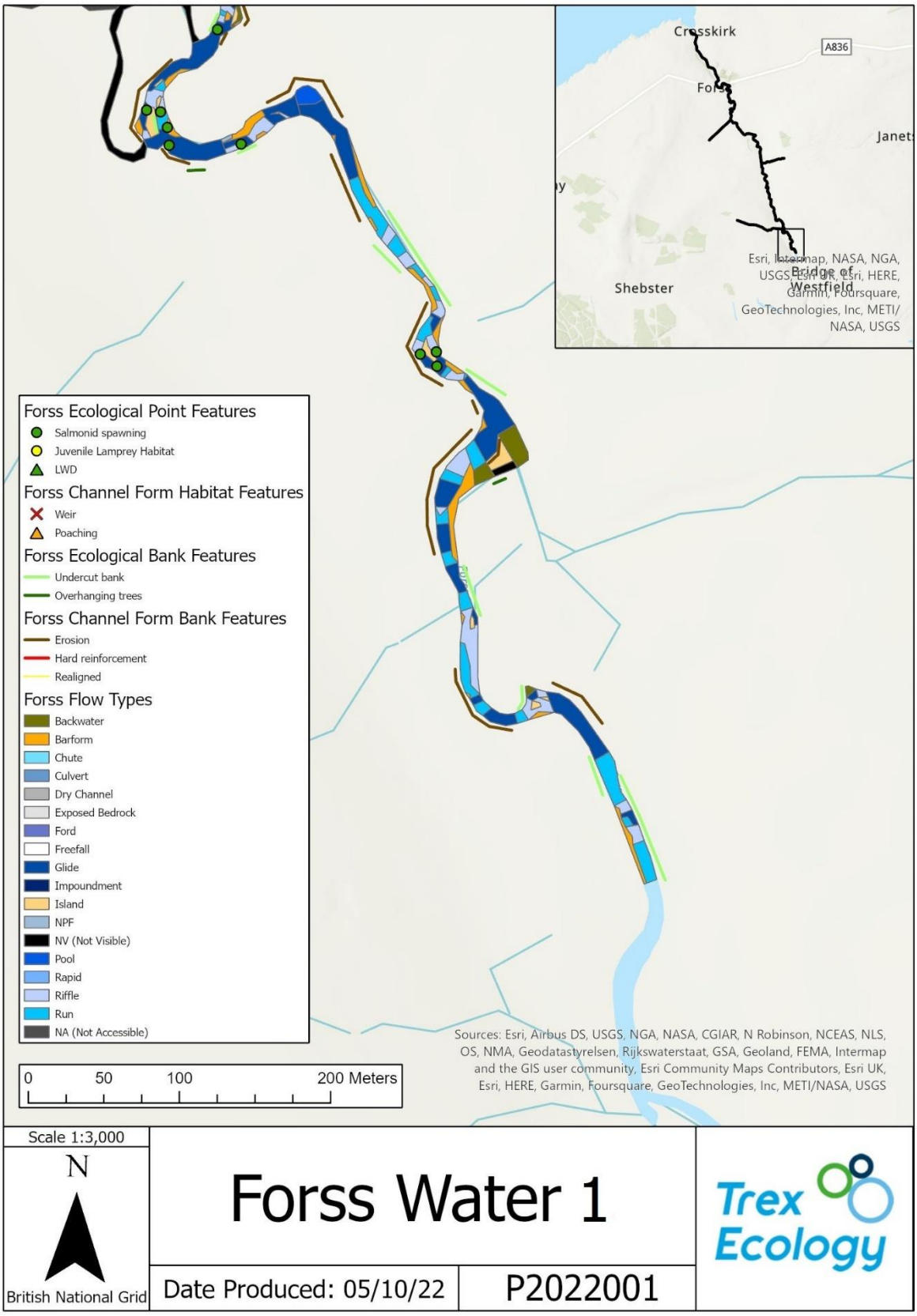
B1.25. Alltan Ghuinne, rapid survey, map 1

B2 Forss Catchment Detailed Walkovers

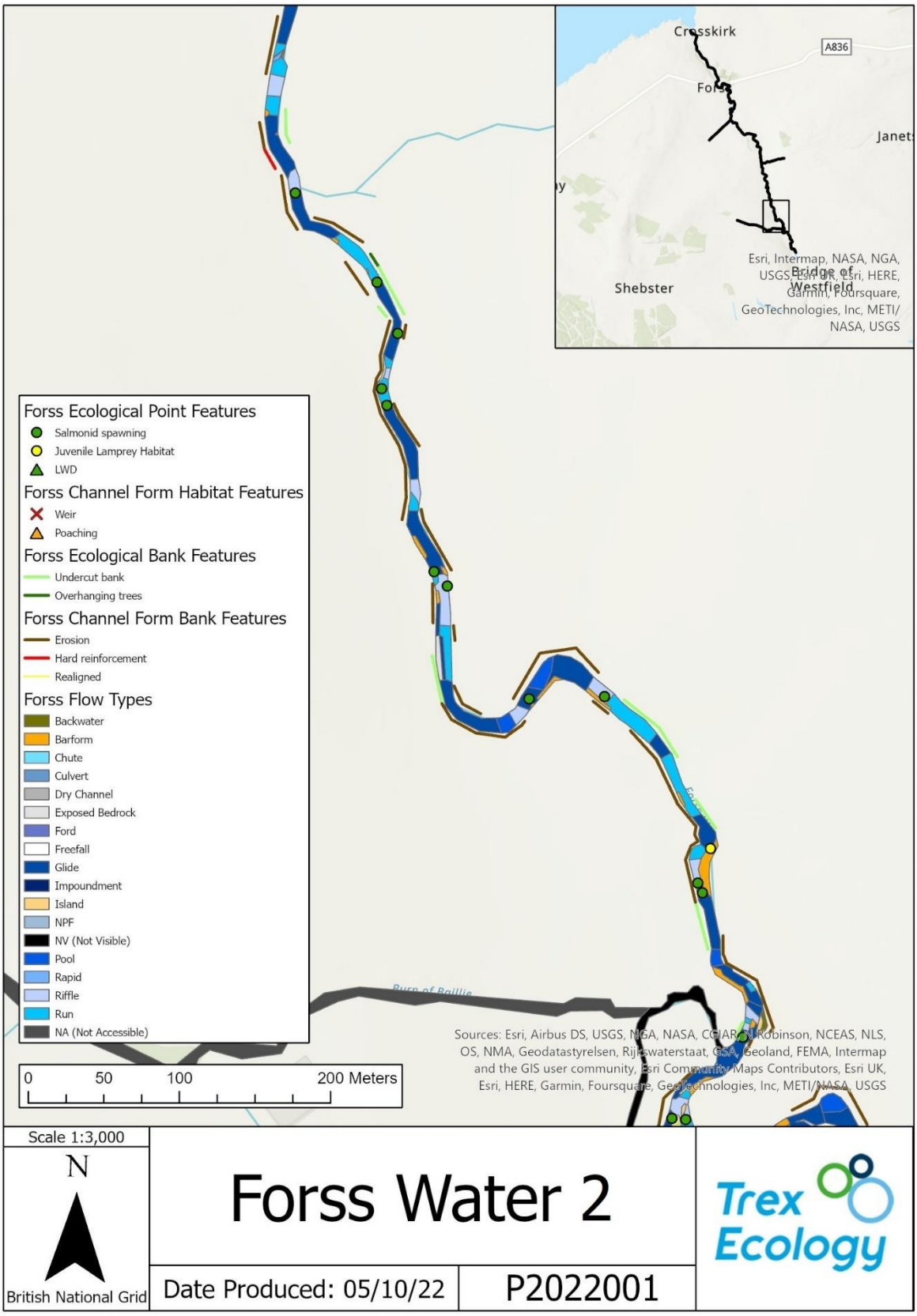
Presented in Appendix B2 are the results of the detailed walkovers for the Forss Catchment.

B2.1 Forss Water

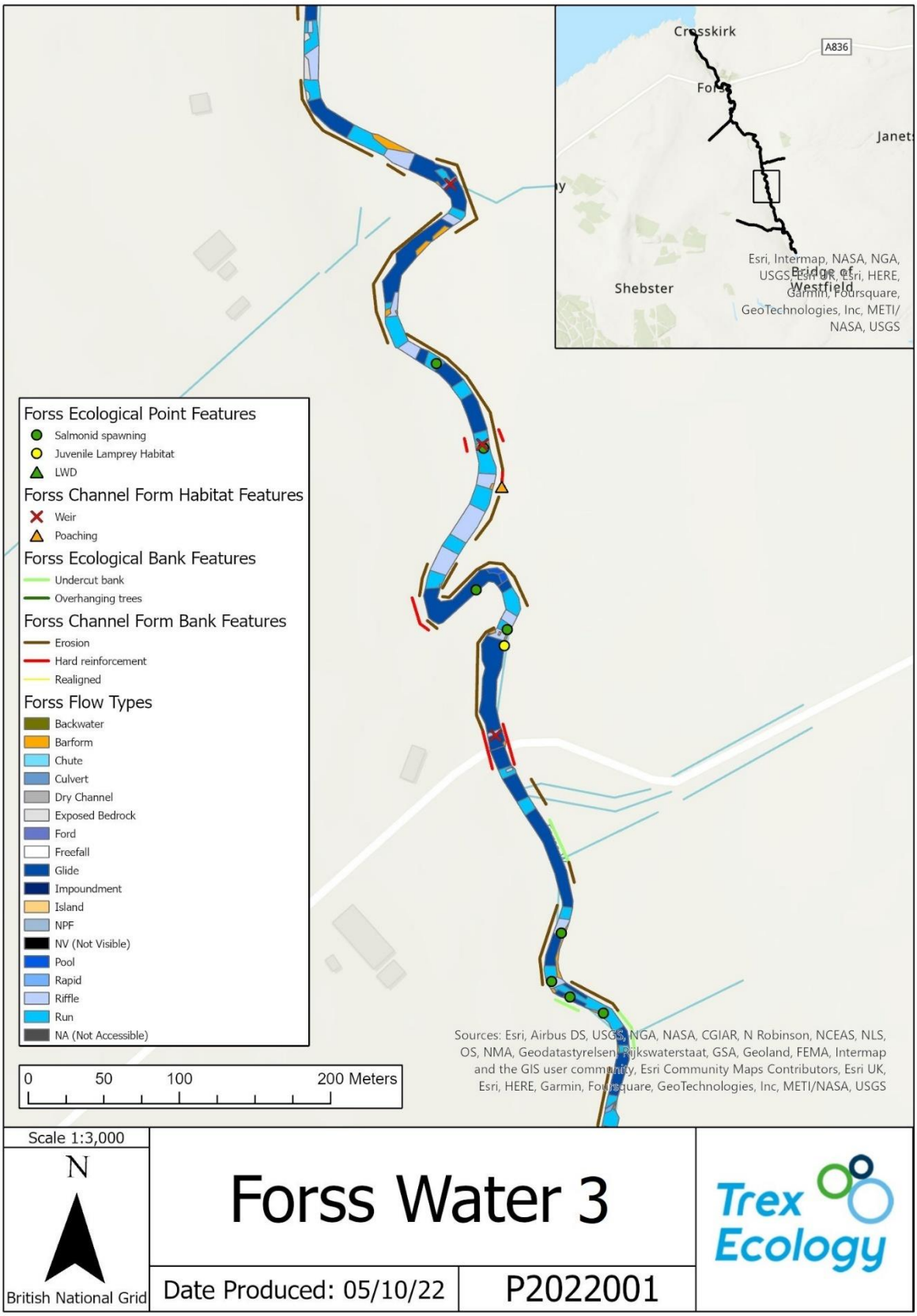
The maps for the Forss Water are set at a scale of 1:3,000.



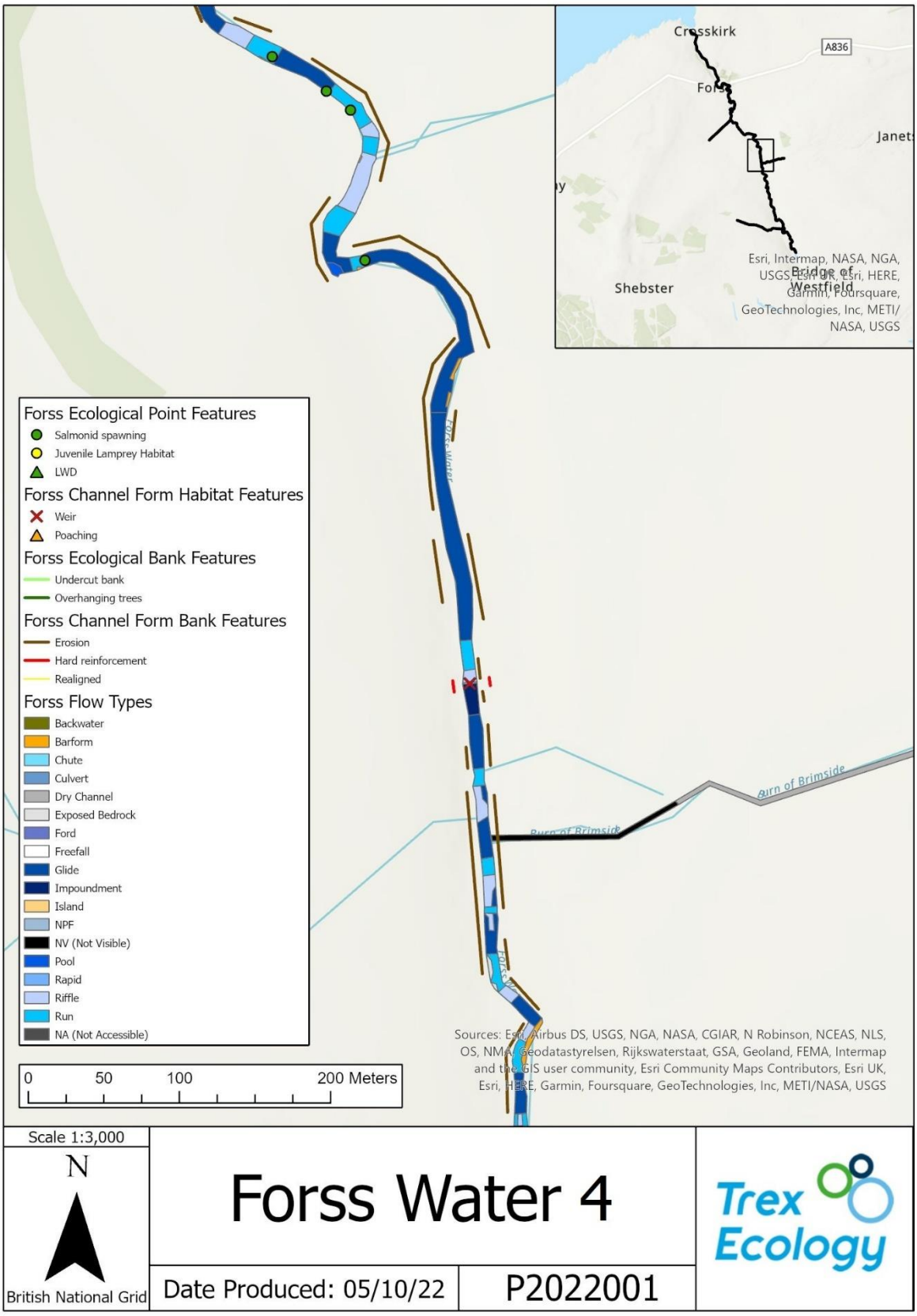
B2.1. Forss Water, detailed walkover, map 1



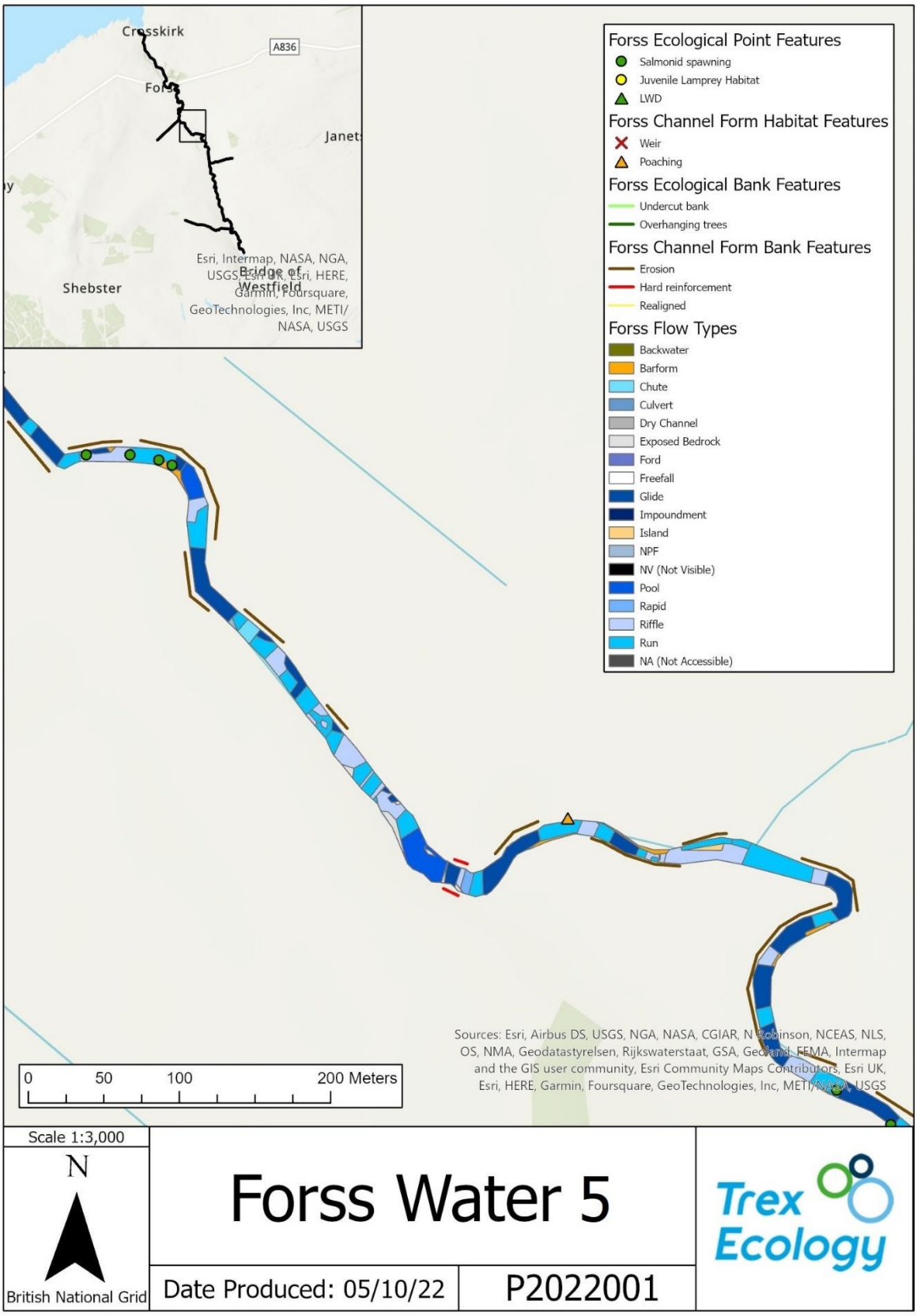
B2.2. Forss Water, detailed walkover, map 2



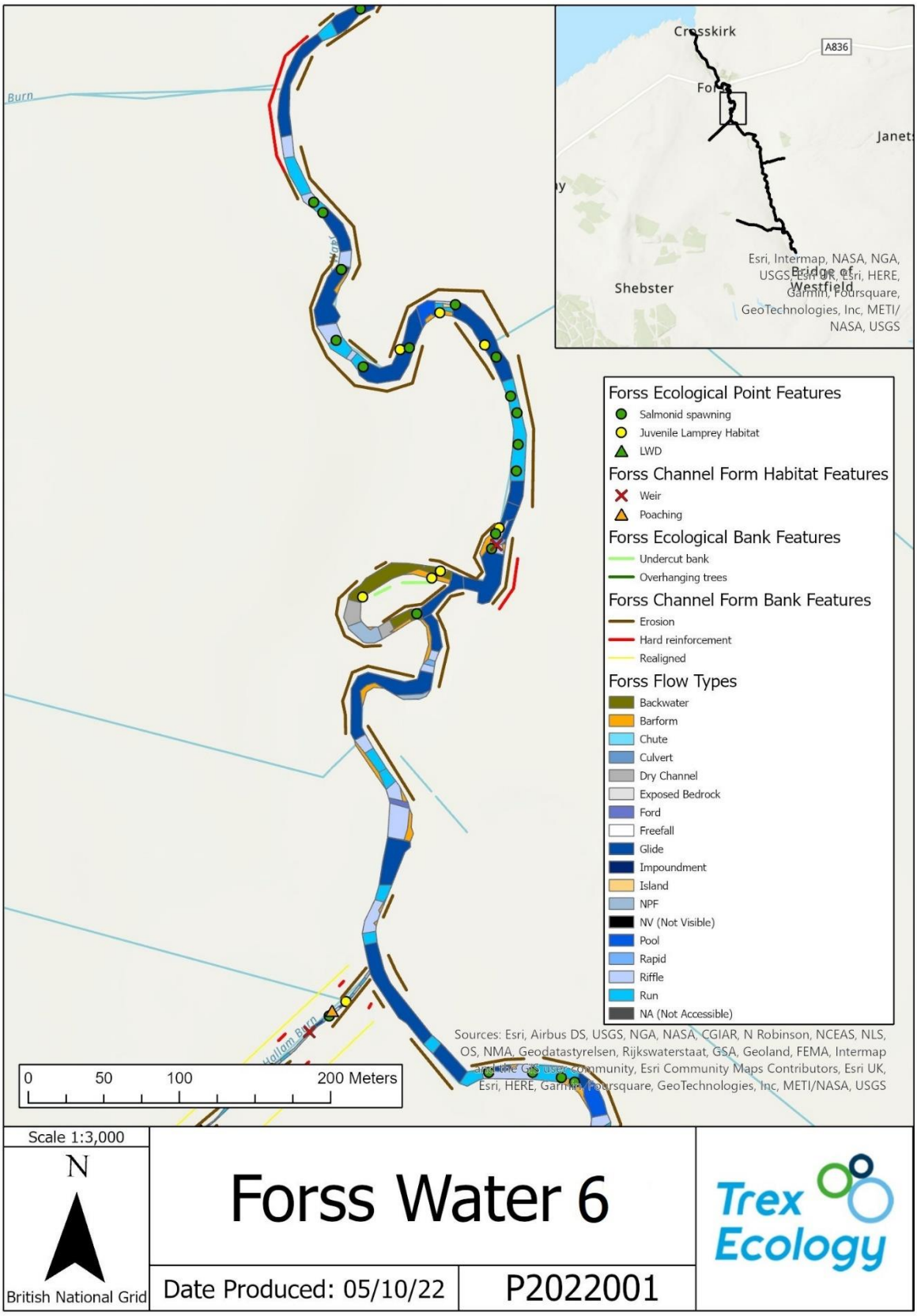
B2.3. Forss Water, detailed walkover, map 3



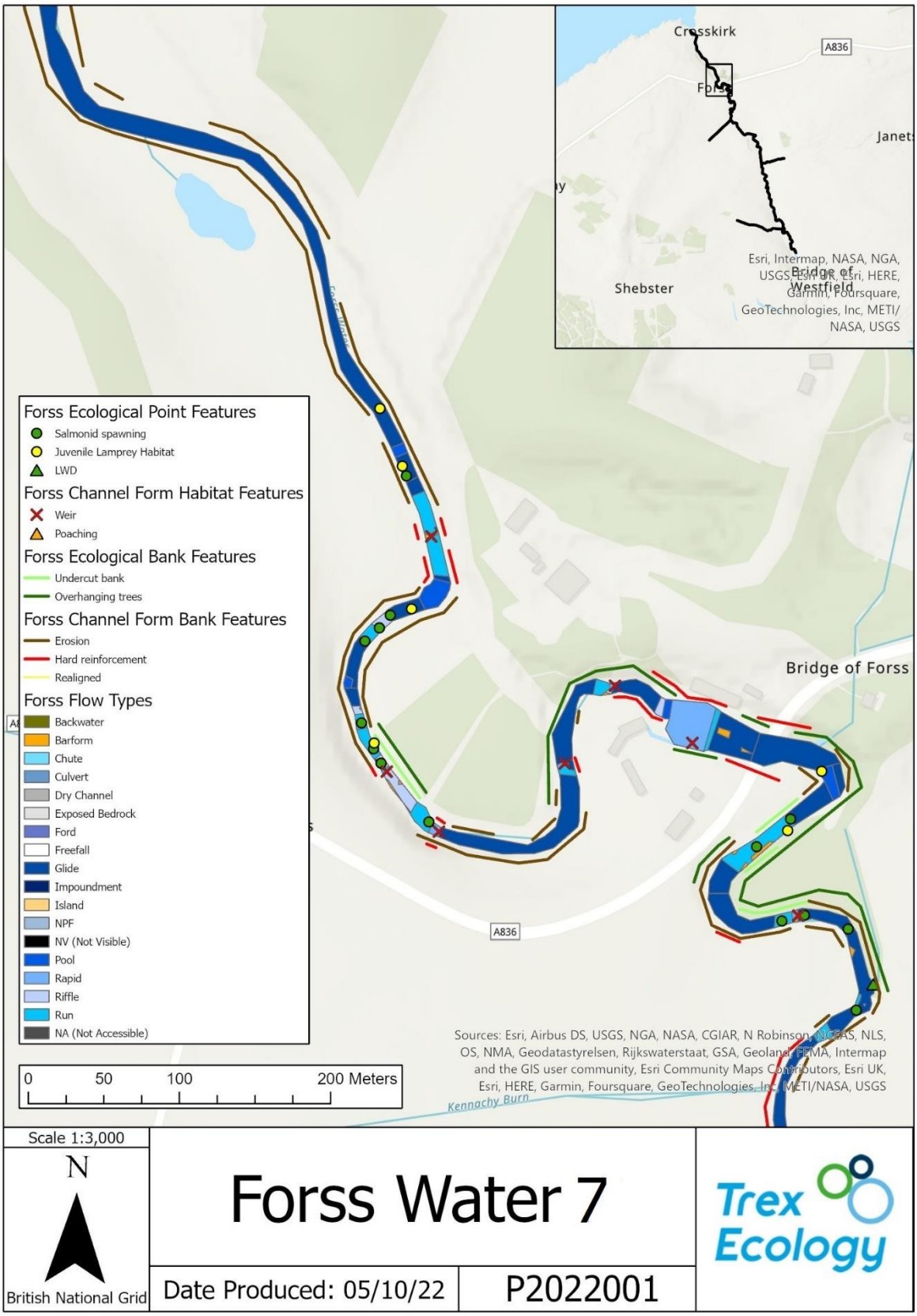
B2.4. Forss Water, detailed walkover, map 4



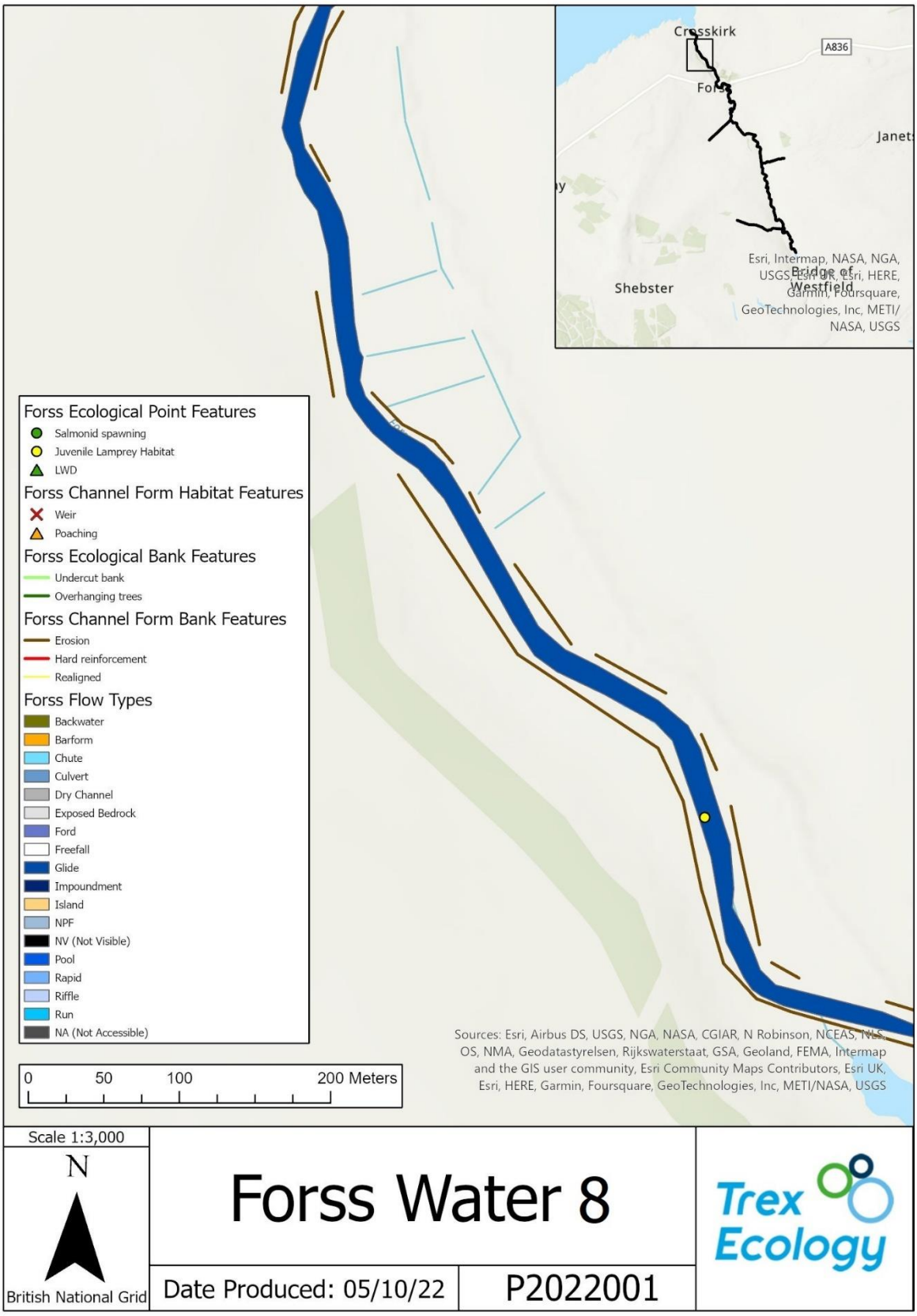
B2.5. Forss Water, detailed walkover, map 5



B2.6. Forss Water, detailed walkover, map 6



B2.7. Forss Water, detailed walkover, map 7

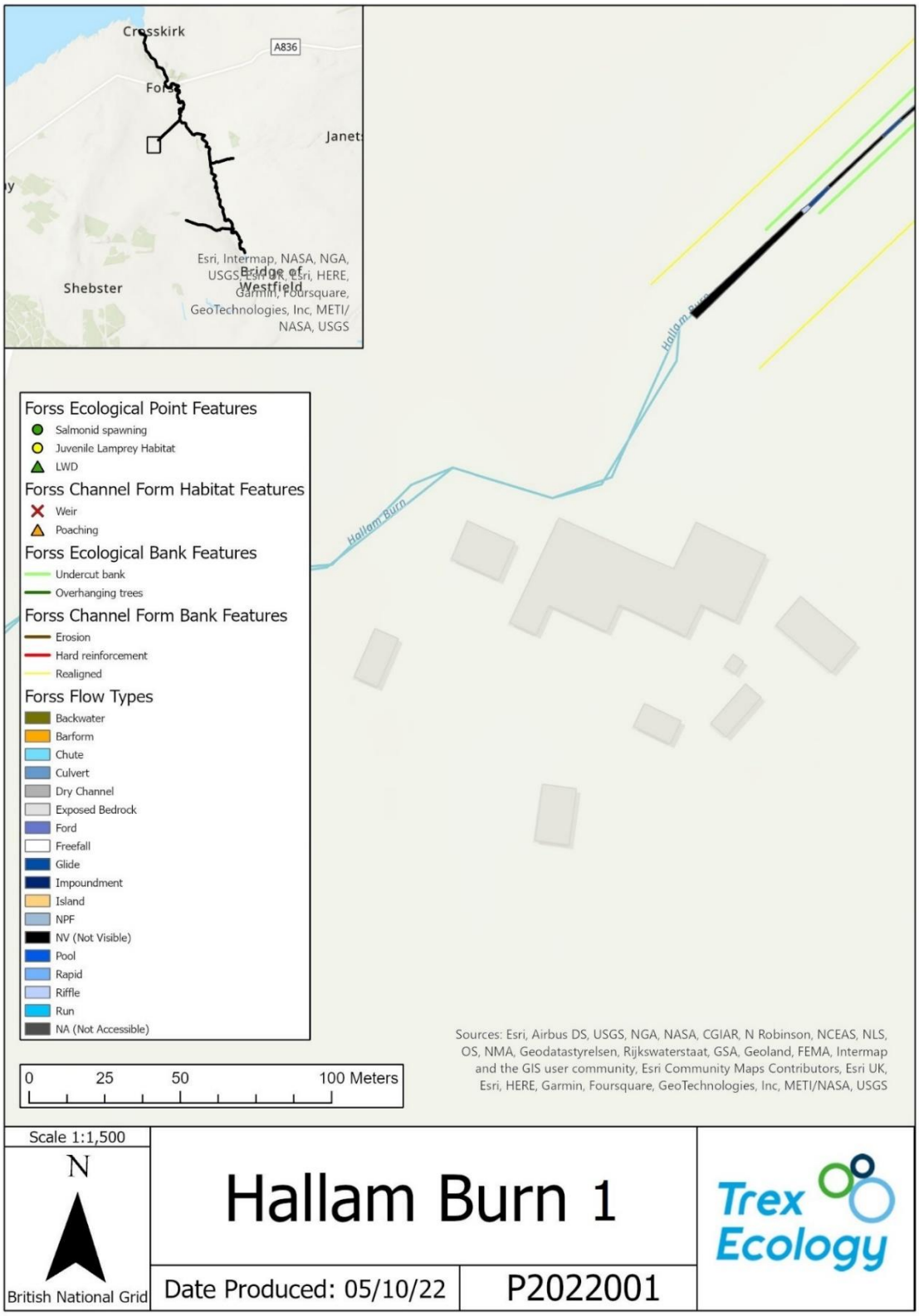


B2.8. Forss Water, detailed walkover, map 8

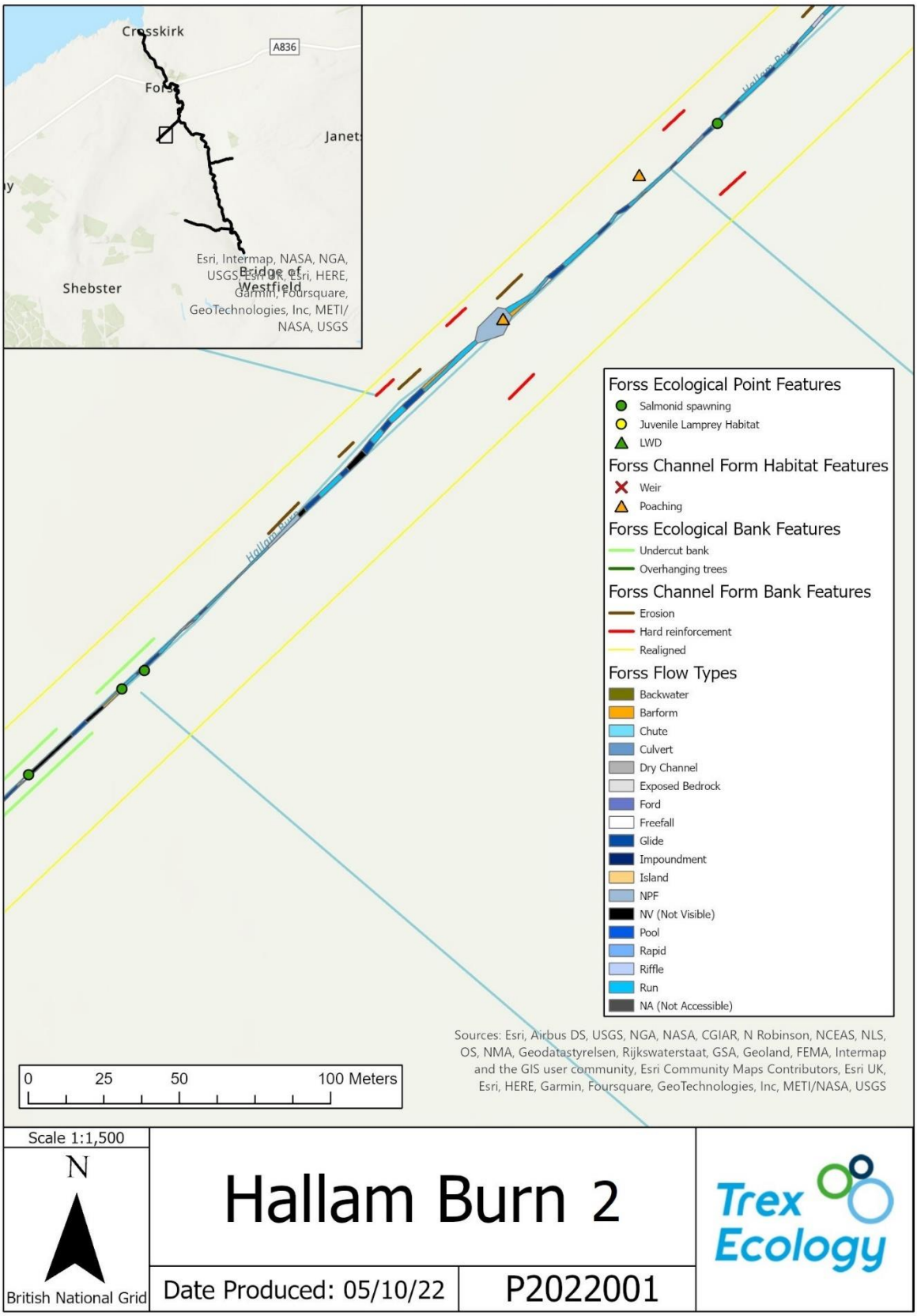
B2.9. Forss Water, detailed walkover, map 9

B2.2 Hallam Burn

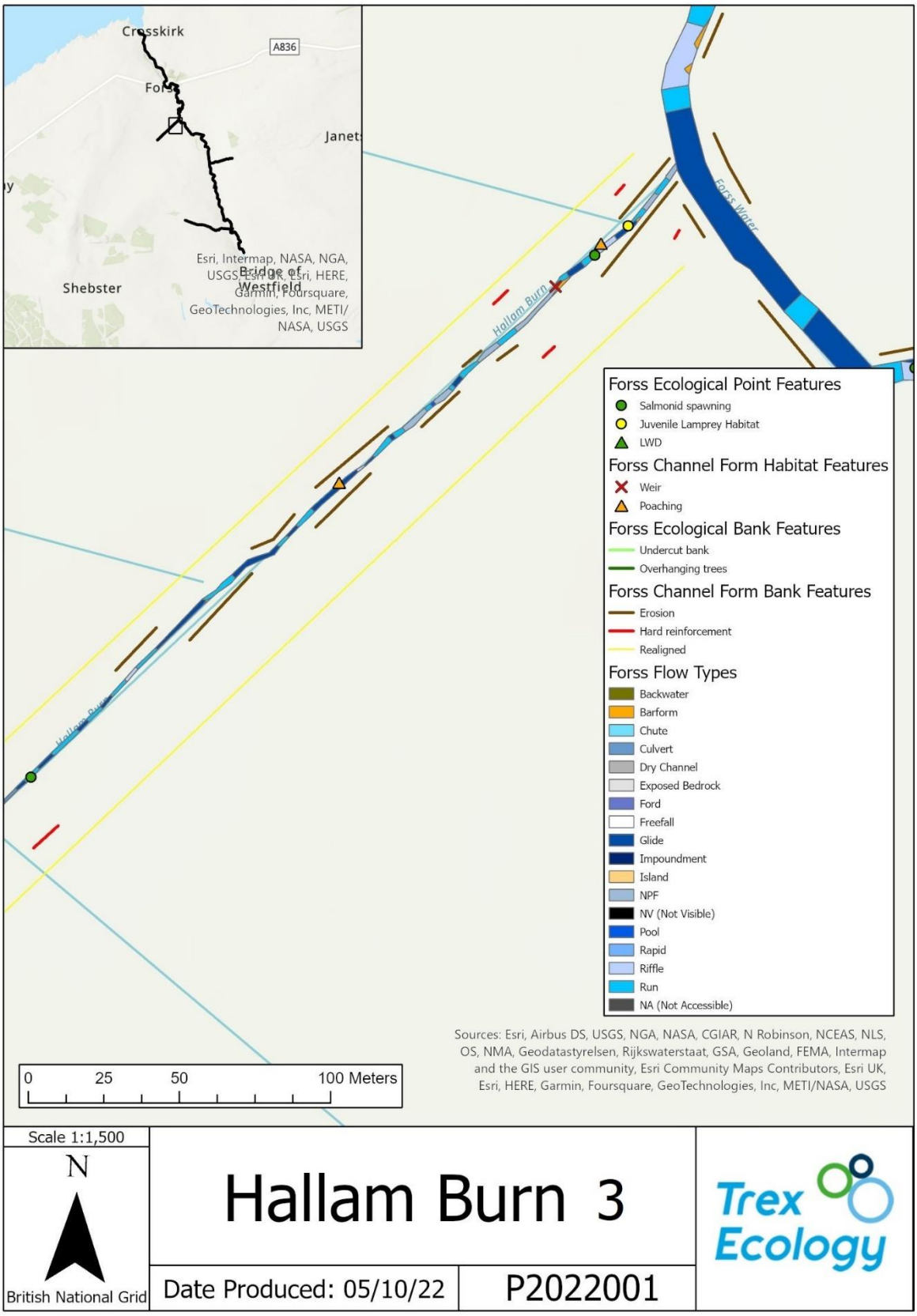
The maps for Hallam Burn are set at a scale of 1:1,500.



B2.10. Hallam Burn, detailed walkover, map 1



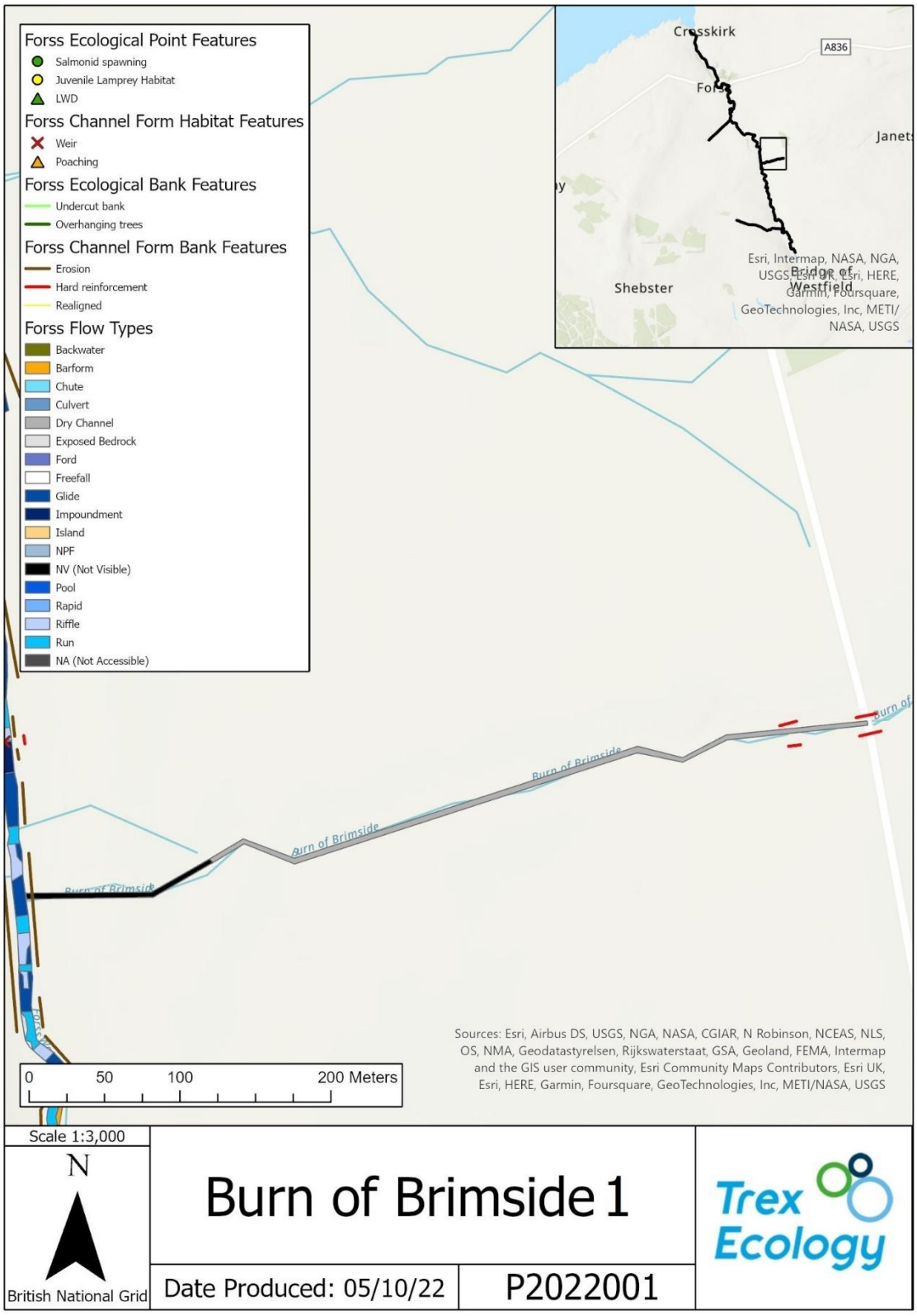
B2.11. Hallam Burn, detailed walkover, map 2



B2.12. Hallam Burn, detailed walkover, map 3

B2.3 Burn of Brimside

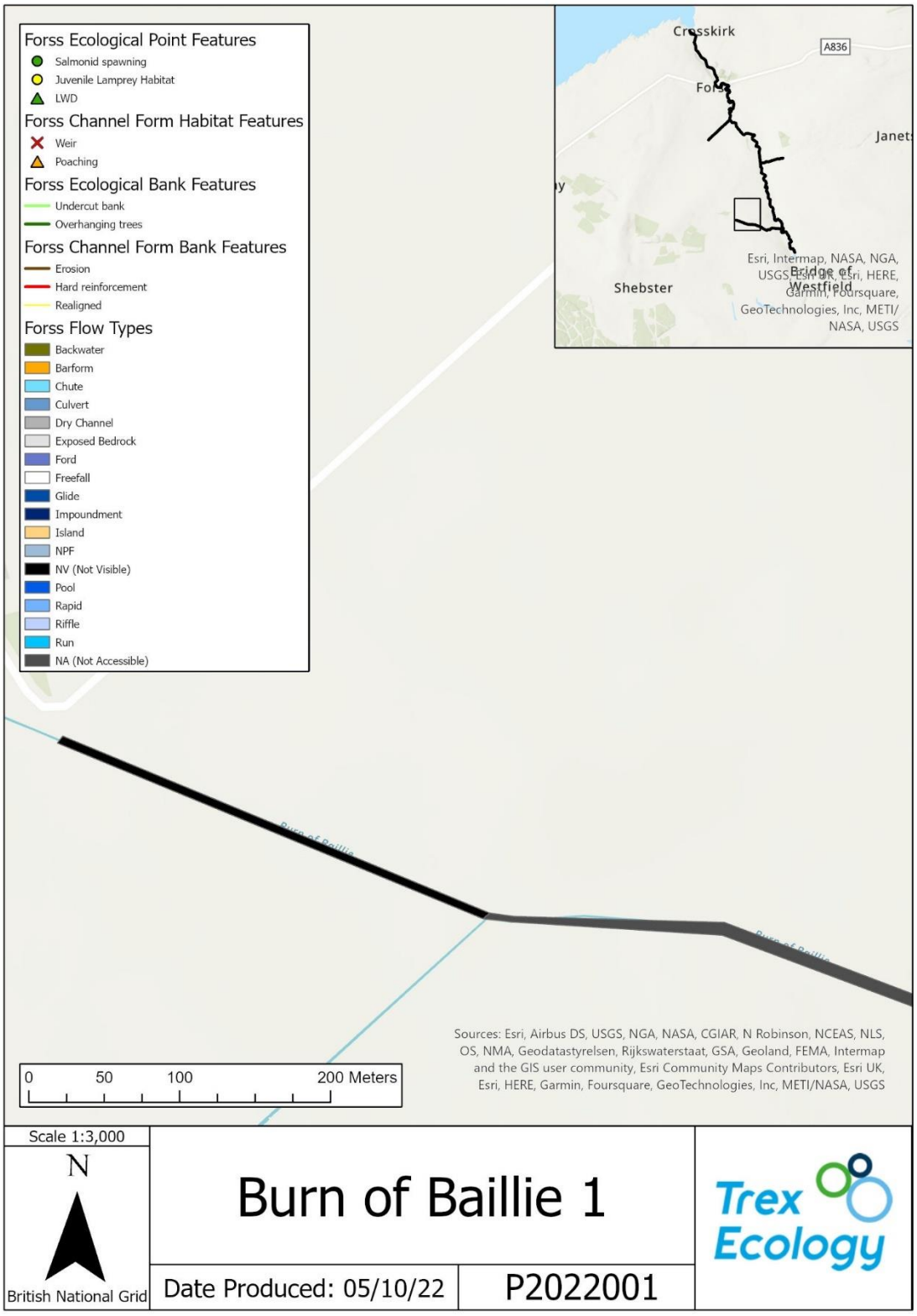
The maps for Burn of Brimside are set at a scale of 1:3,000.



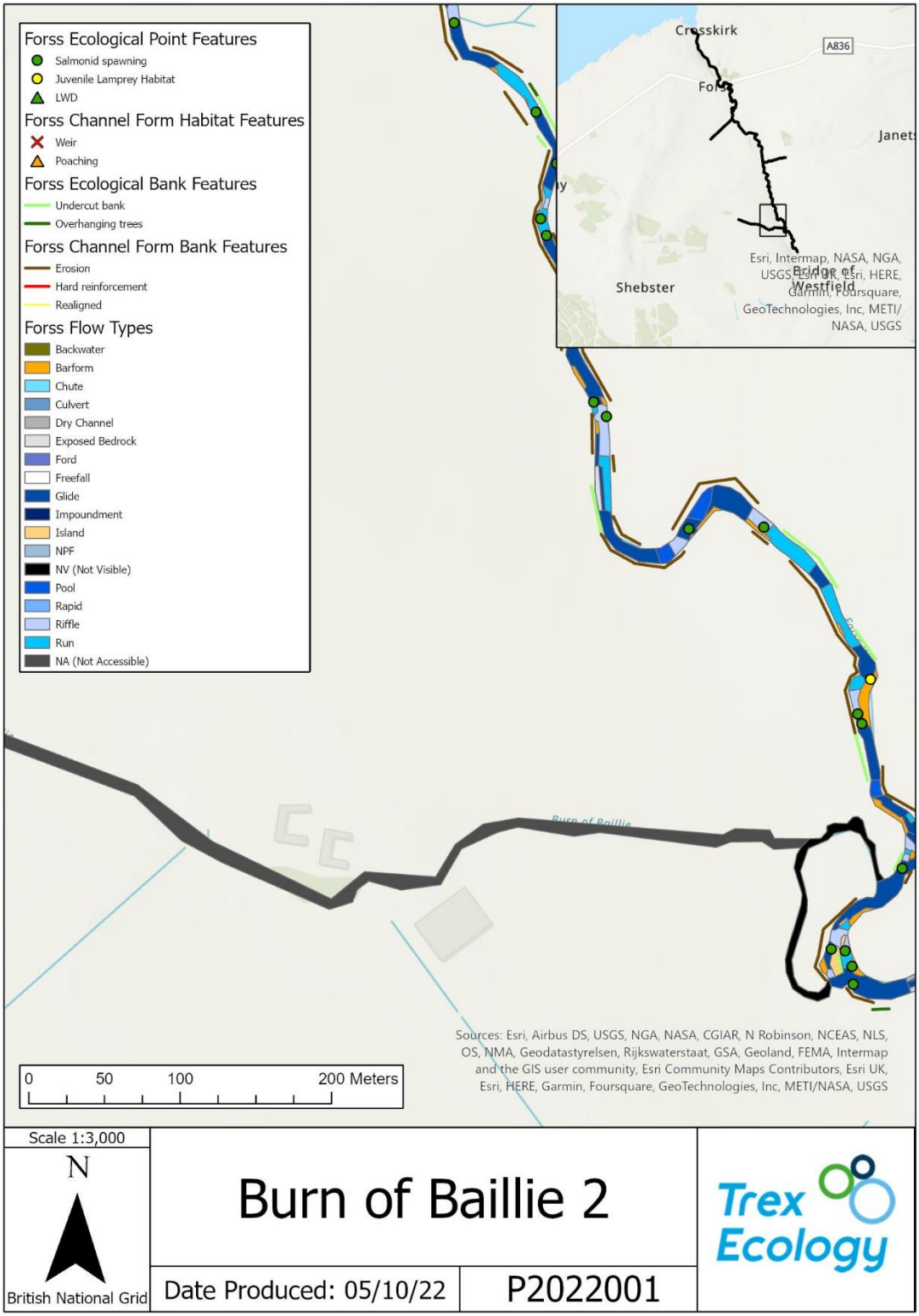
B2.13. Burn of Brimside, detailed walkover, map 1

B2.4 Burn of Baillie

The maps for Burn of Baillie are set at a scale of 1:3,000.



B2.14. Burn of Baillie, detailed walkover, map 1



B2.15. Burn of Baillie, detailed walkover, map 2

Appendix C – Habitat map book; River Thurso

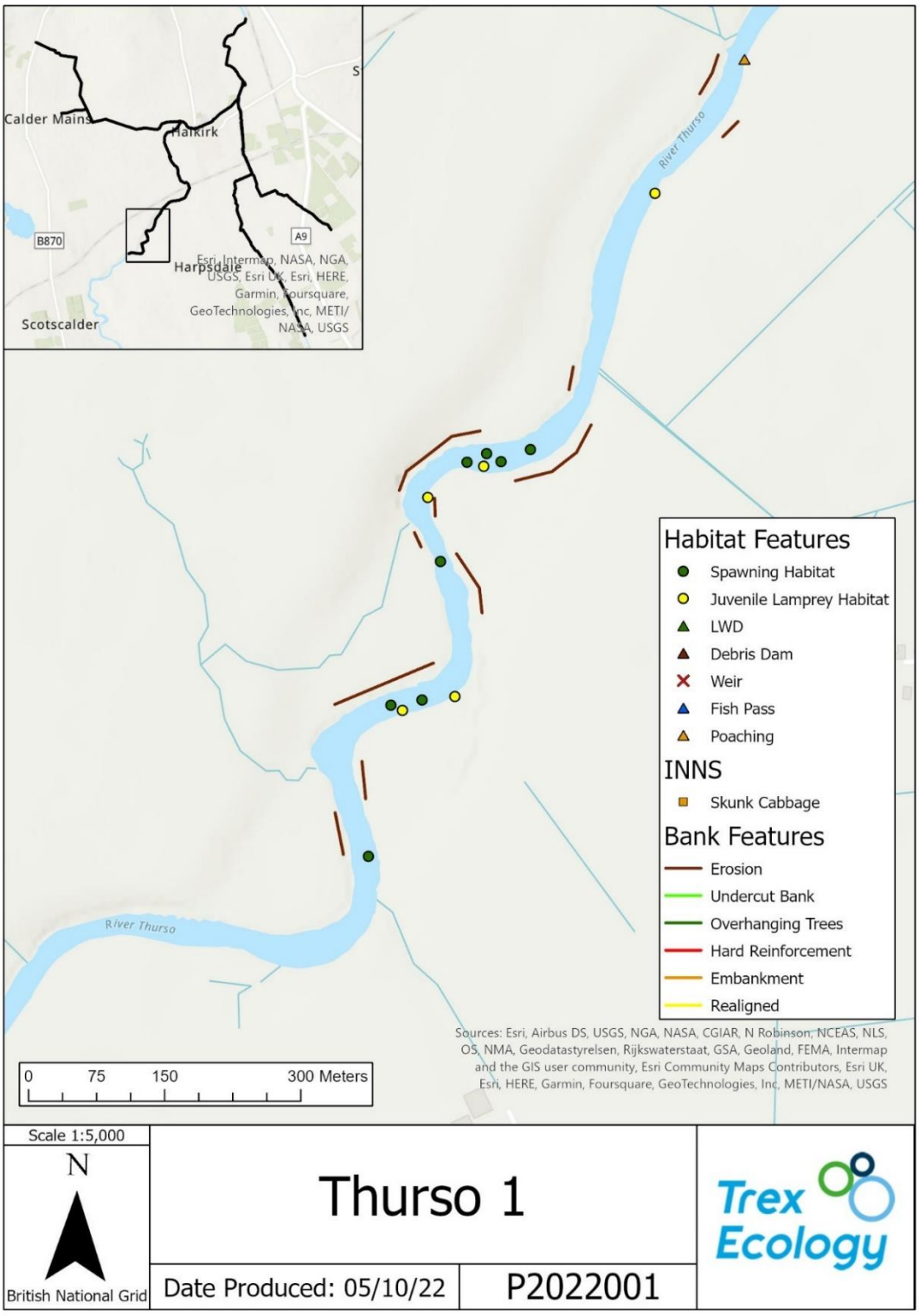
As the reconnaissance and detailed habitat walkover were carried out during different phases of the cable route refinement (See Section 1), two distinct map books have been produced. Section C1 presents the data from the reconnaissance walkover, while Section C2 presents the data from the detailed walkover.

C1 Thurso Catchment Recon Walkovers

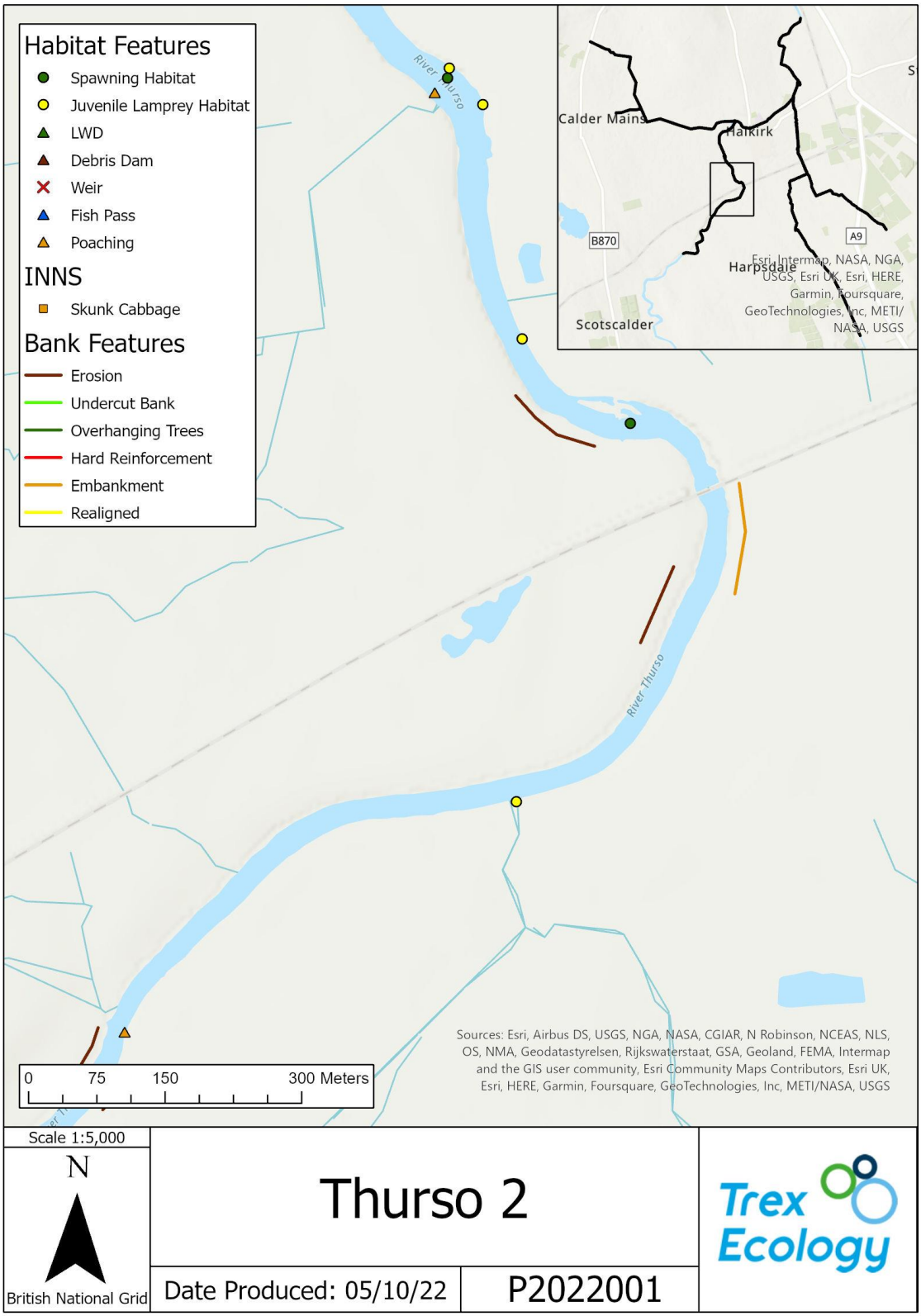
Presented in Appendix C1 are the results of the reconnaissance walkovers for the Thurso Catchment.

C1.1 River Thurso

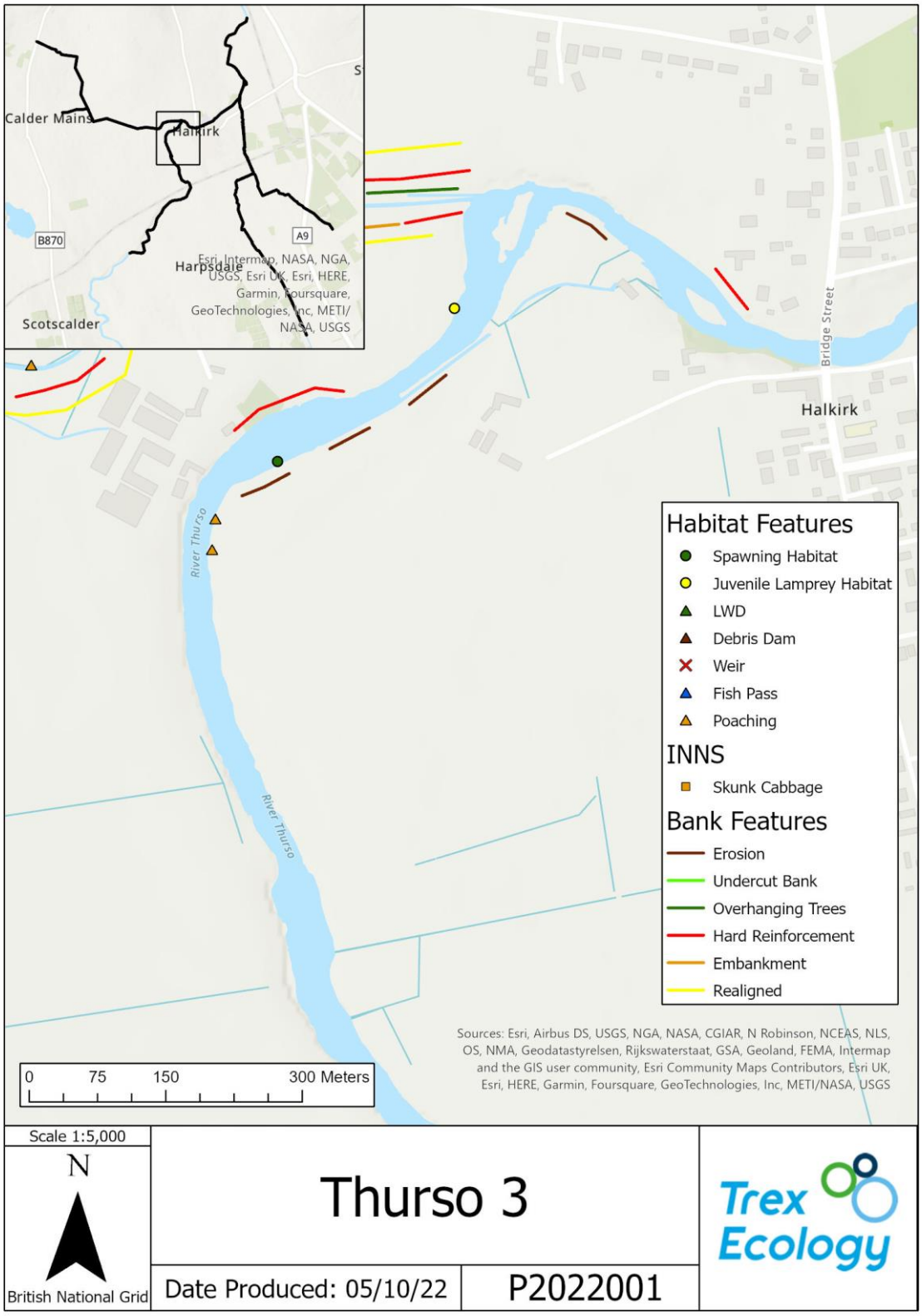
The maps for the River Thurso are set at a scale of 1:5,000.



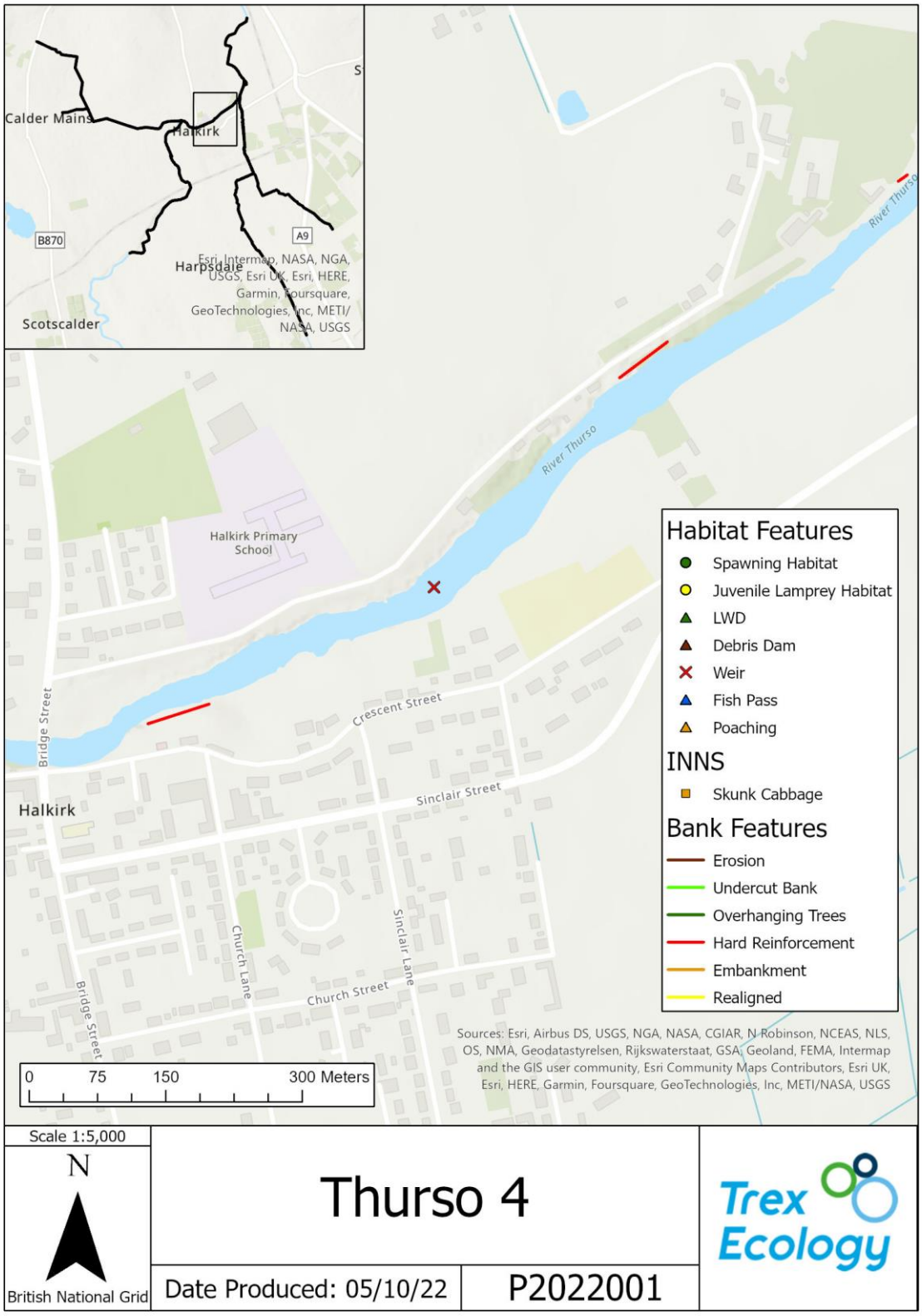
C1.1. River Thurso, rapid survey, map 1



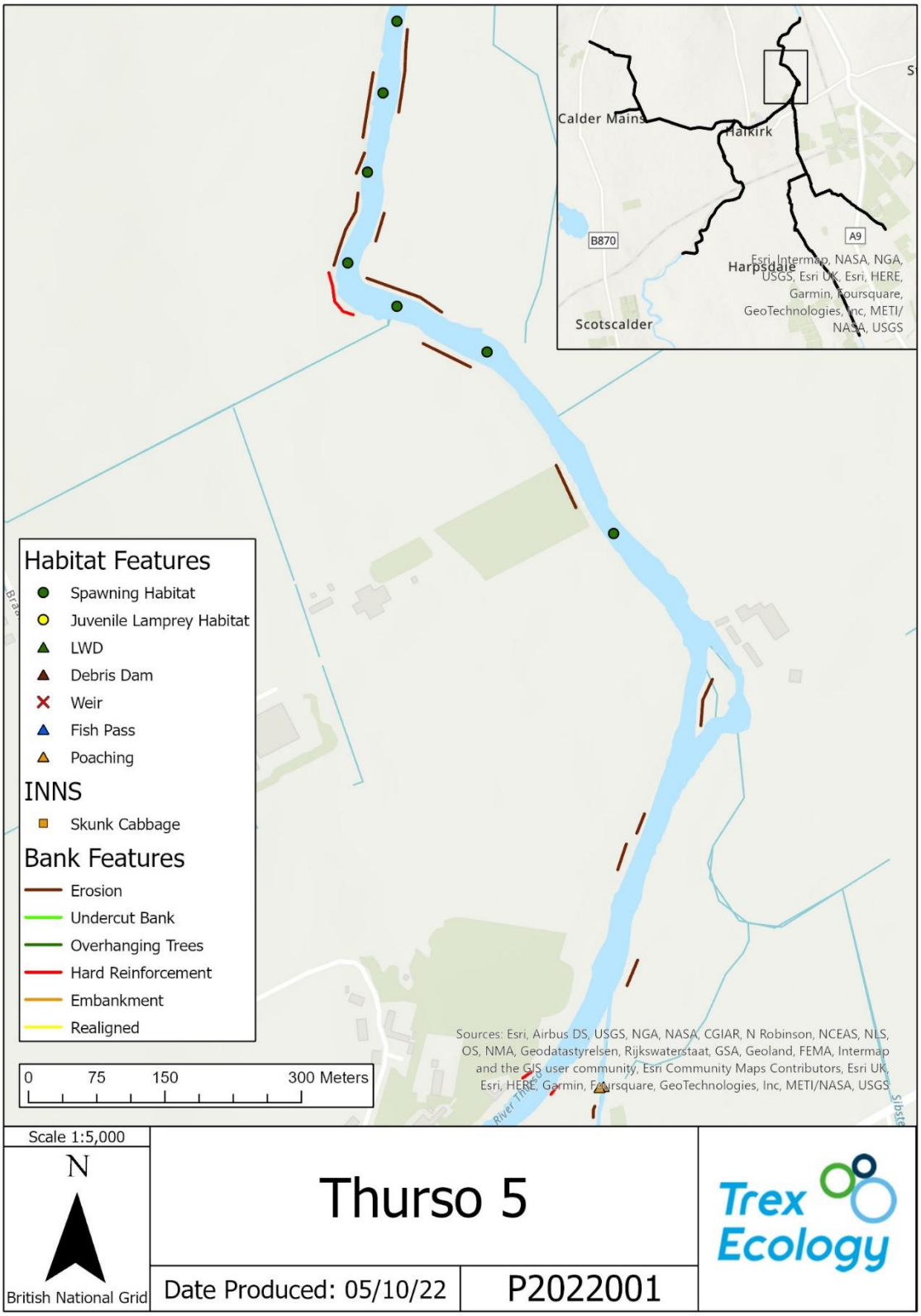
C1.2. River Thurso, rapid survey, map 2



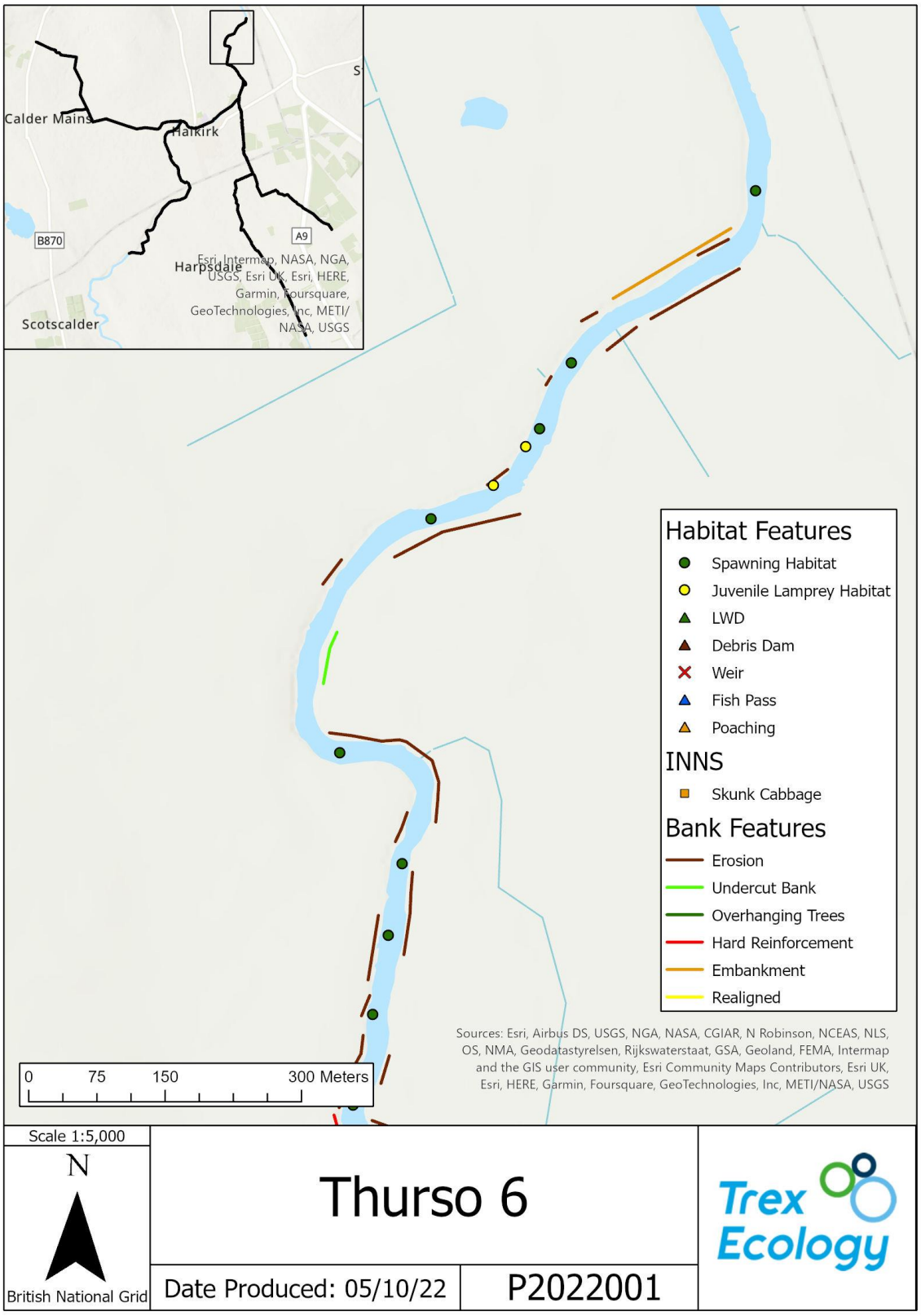
C1.3. River Thurso, rapid survey, map 3



C1.4. River Thurso, rapid survey, map 4



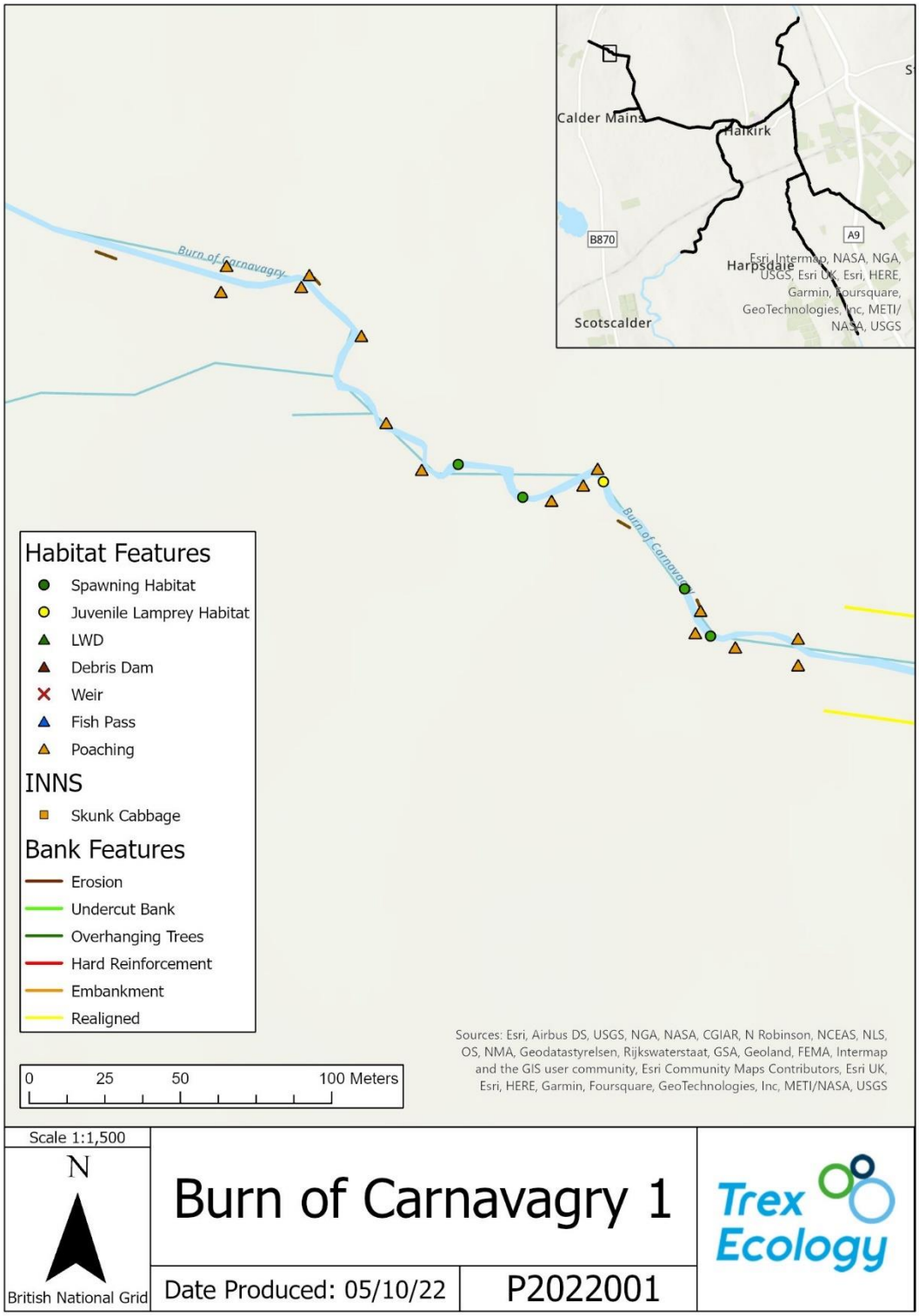
C1.5. River Thurso, rapid survey, map 5



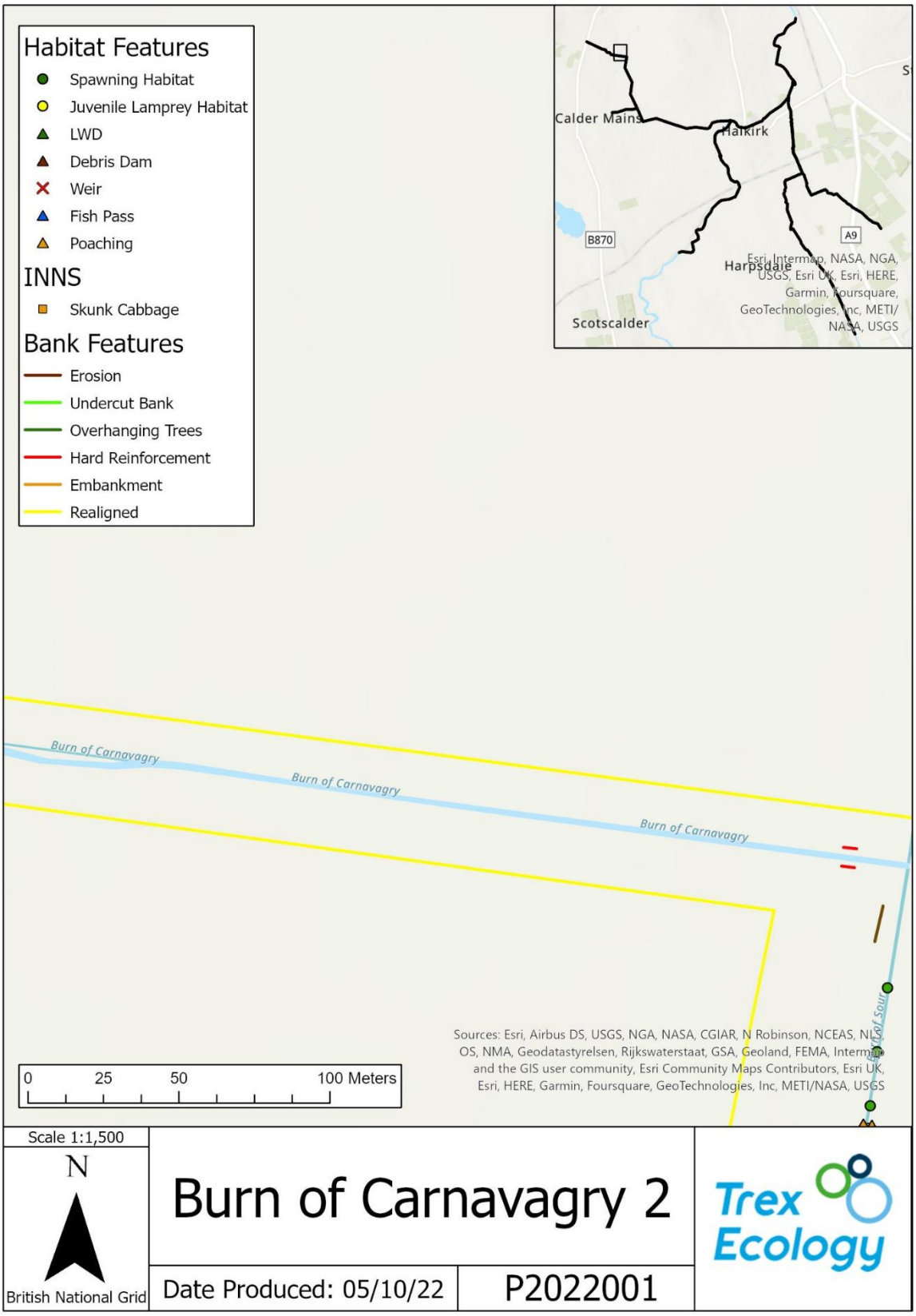
C1.6. River Thurso, rapid survey, map 6

C1.2 Burn of Carnavagry

The maps for Burn of Carnavagry are set at a scale of 1:1,500.



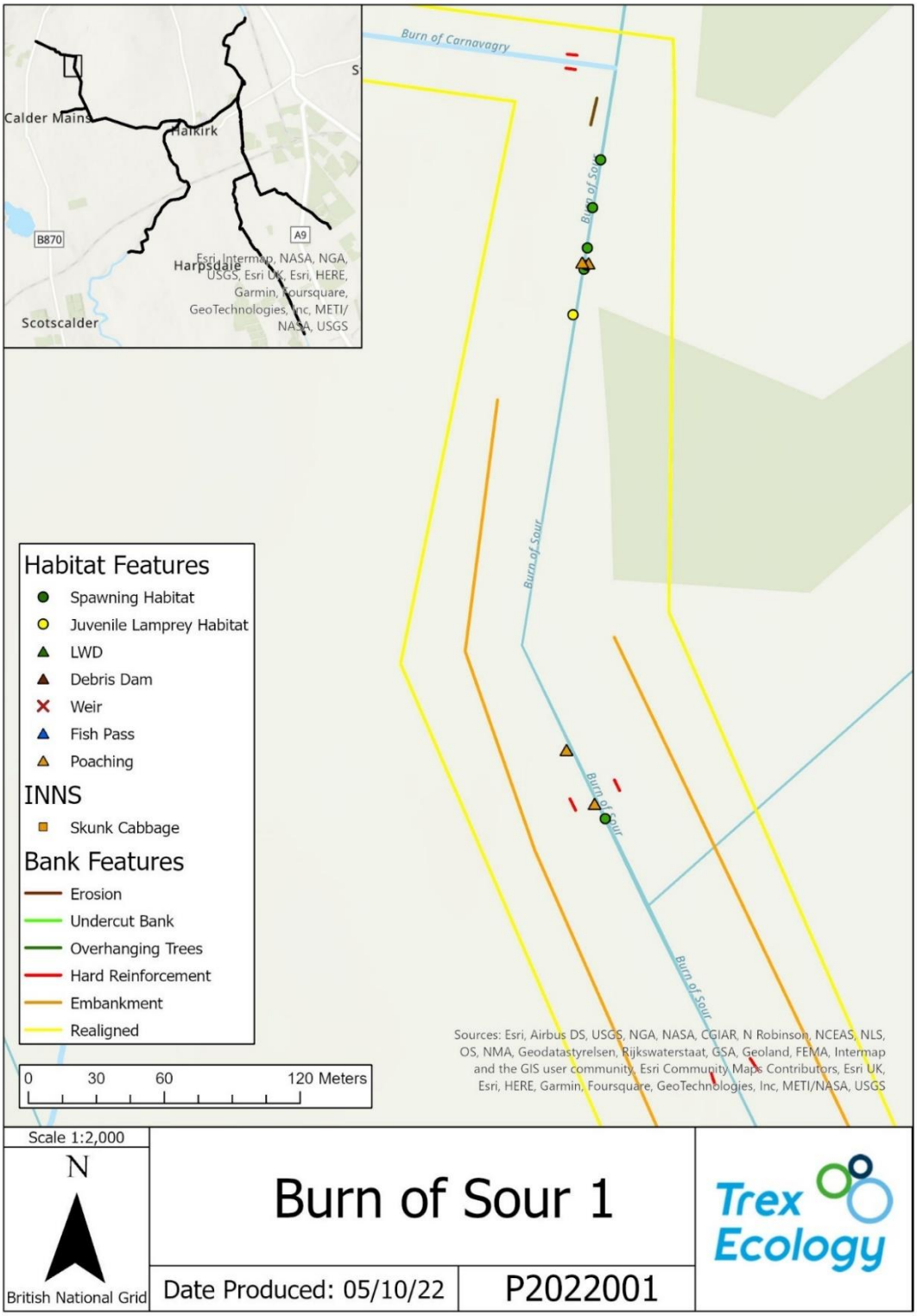
C1.7. Burn of Carnavagry, rapid survey, map 1



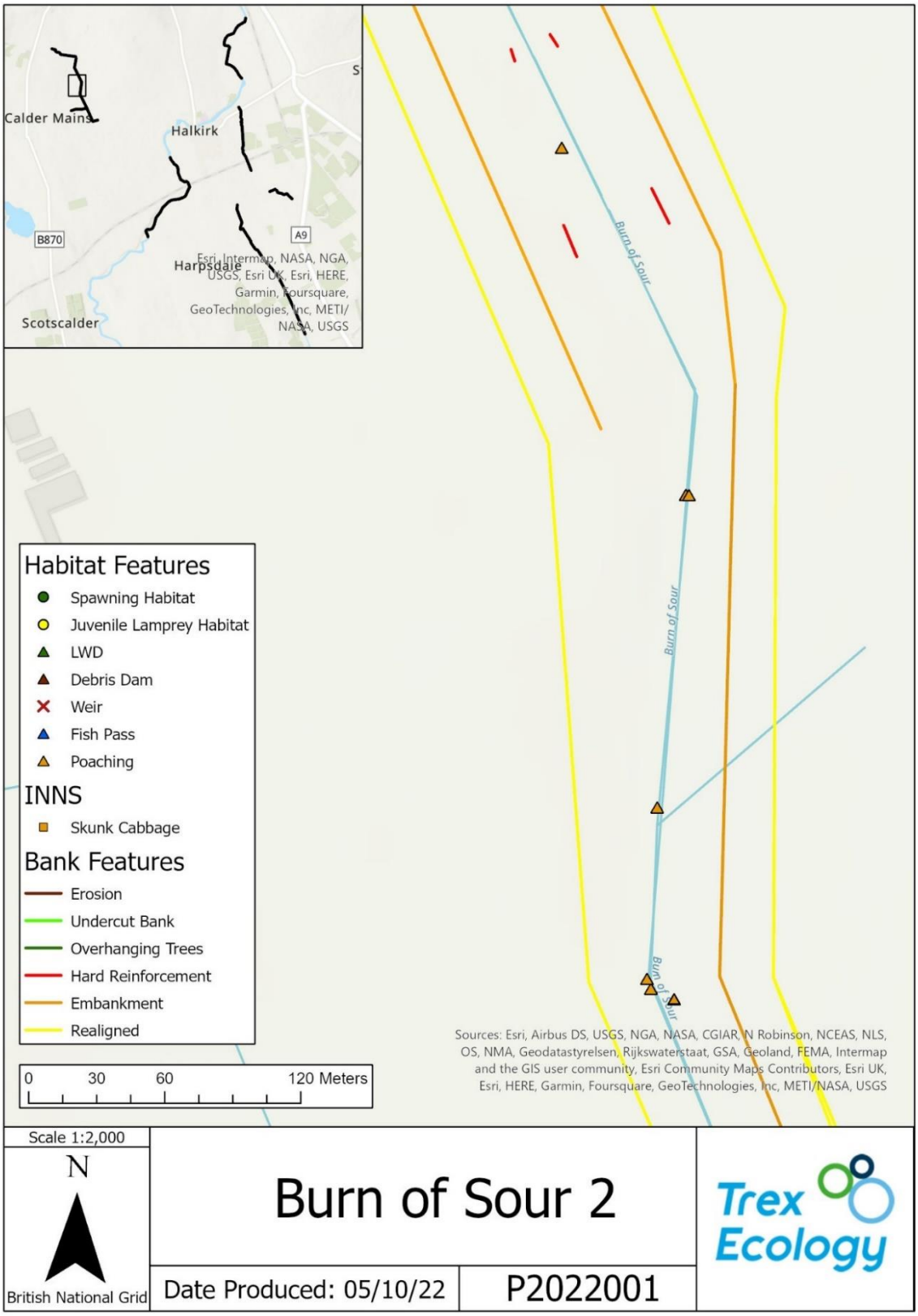
C1.8. Burn of Carnavagry, rapid survey, map 2

C1.3 Burn of Sour

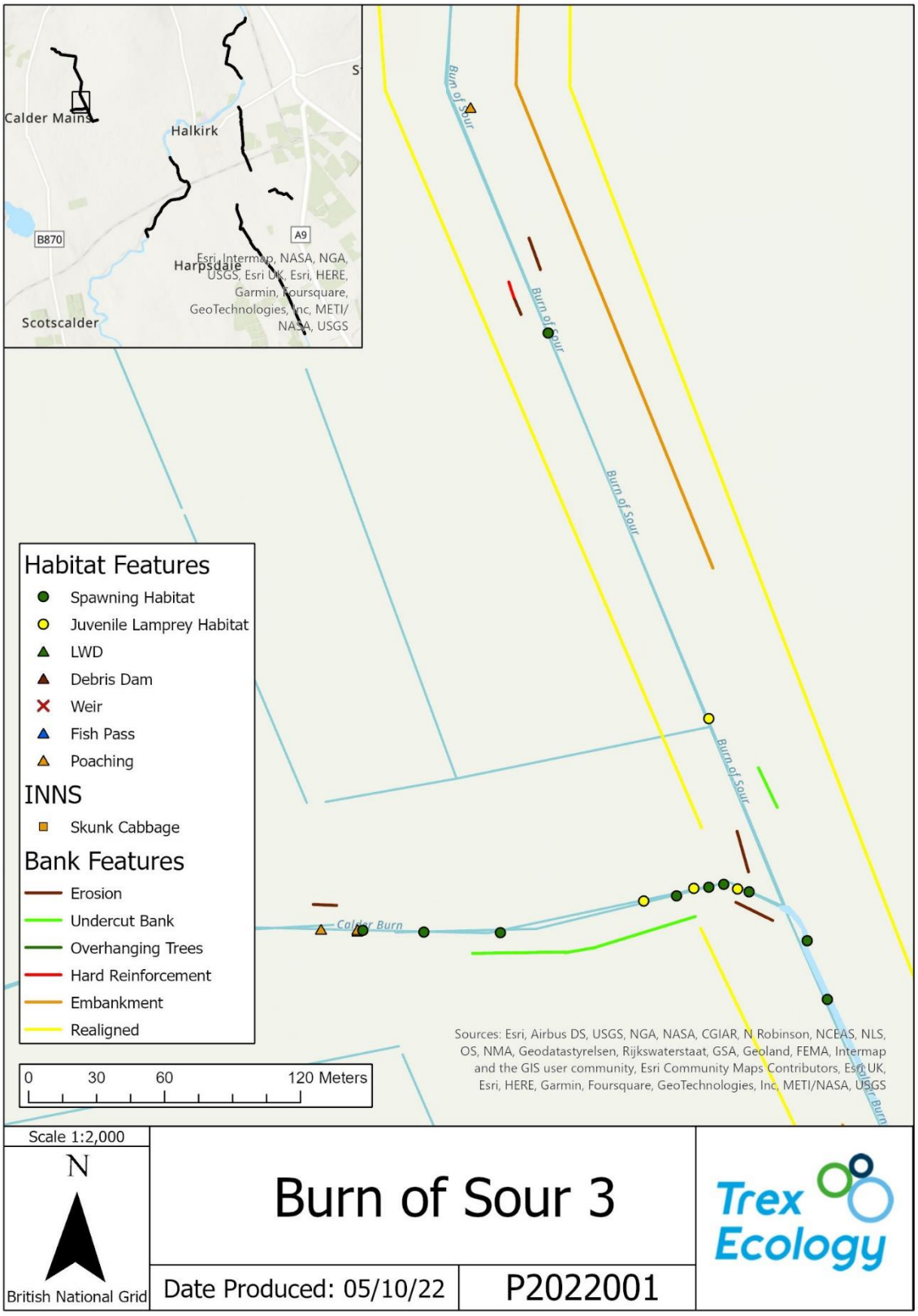
The maps for Burn of Sour are set at a scale of 1:2,000.



C1.9. Burn of Sour, rapid survey, map 1



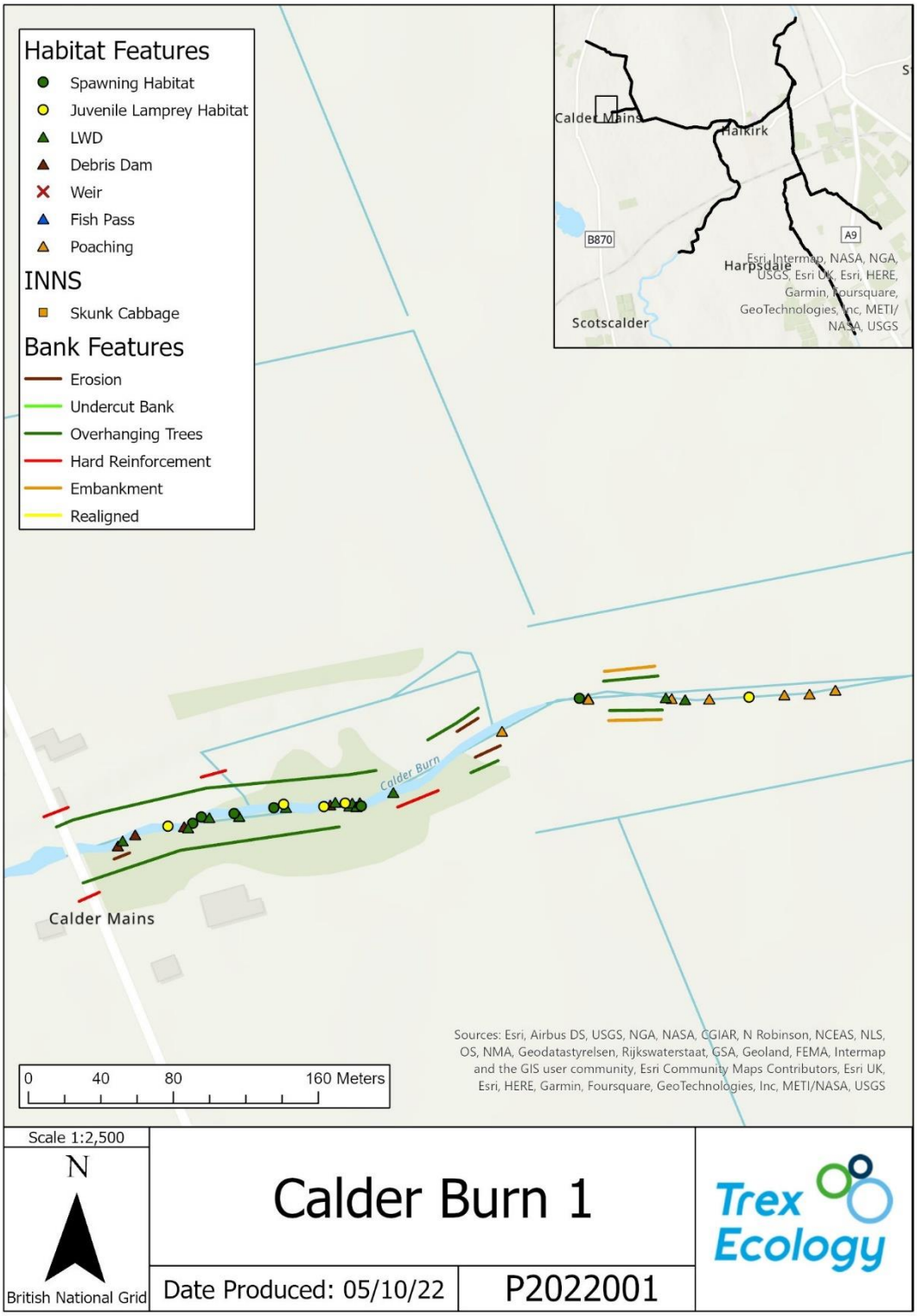
C1.10. Burn of Sour, rapid survey, map 2



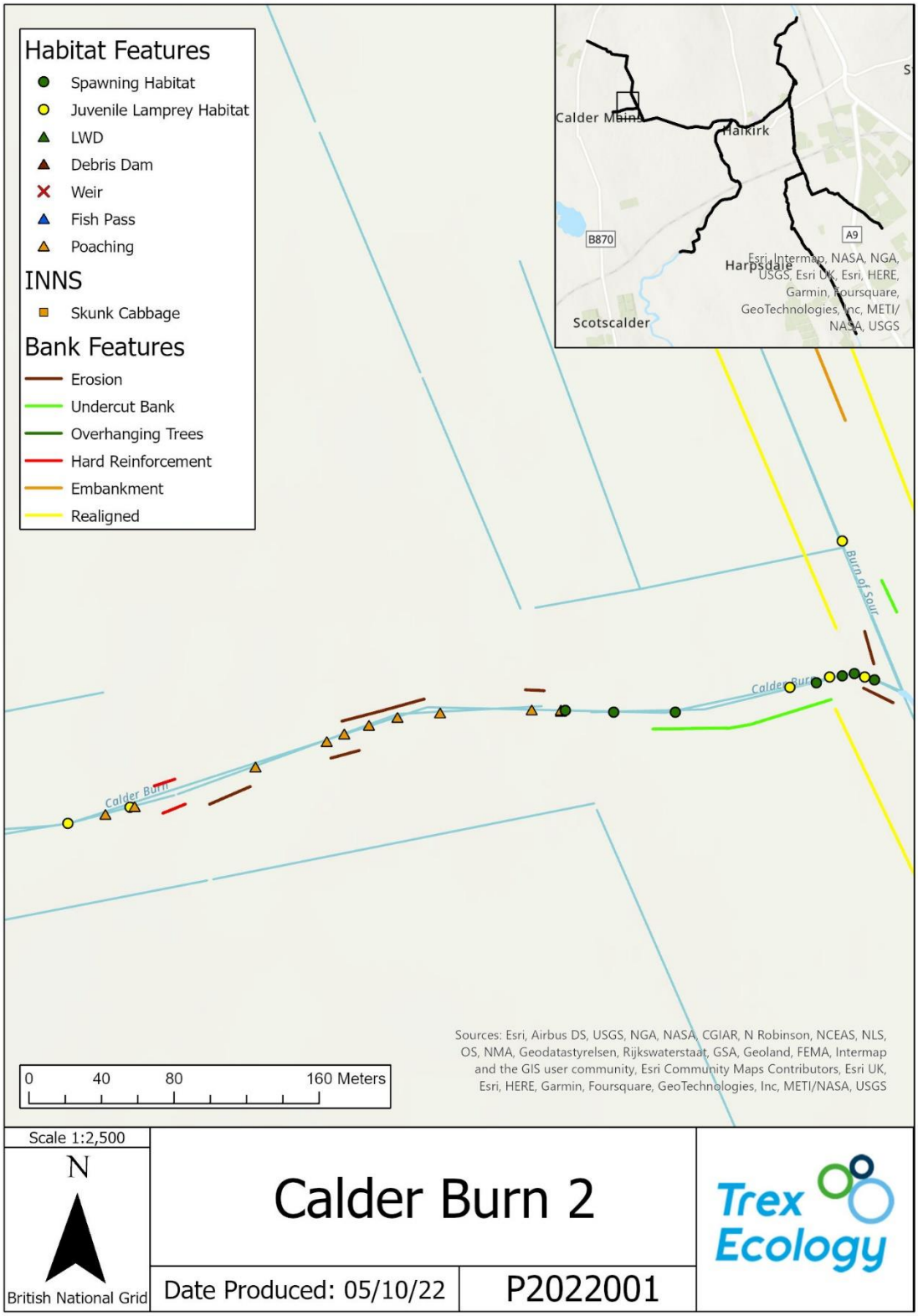
C1.11. Burn of Sour, rapid survey, map 3

C1.4 Calder Burn

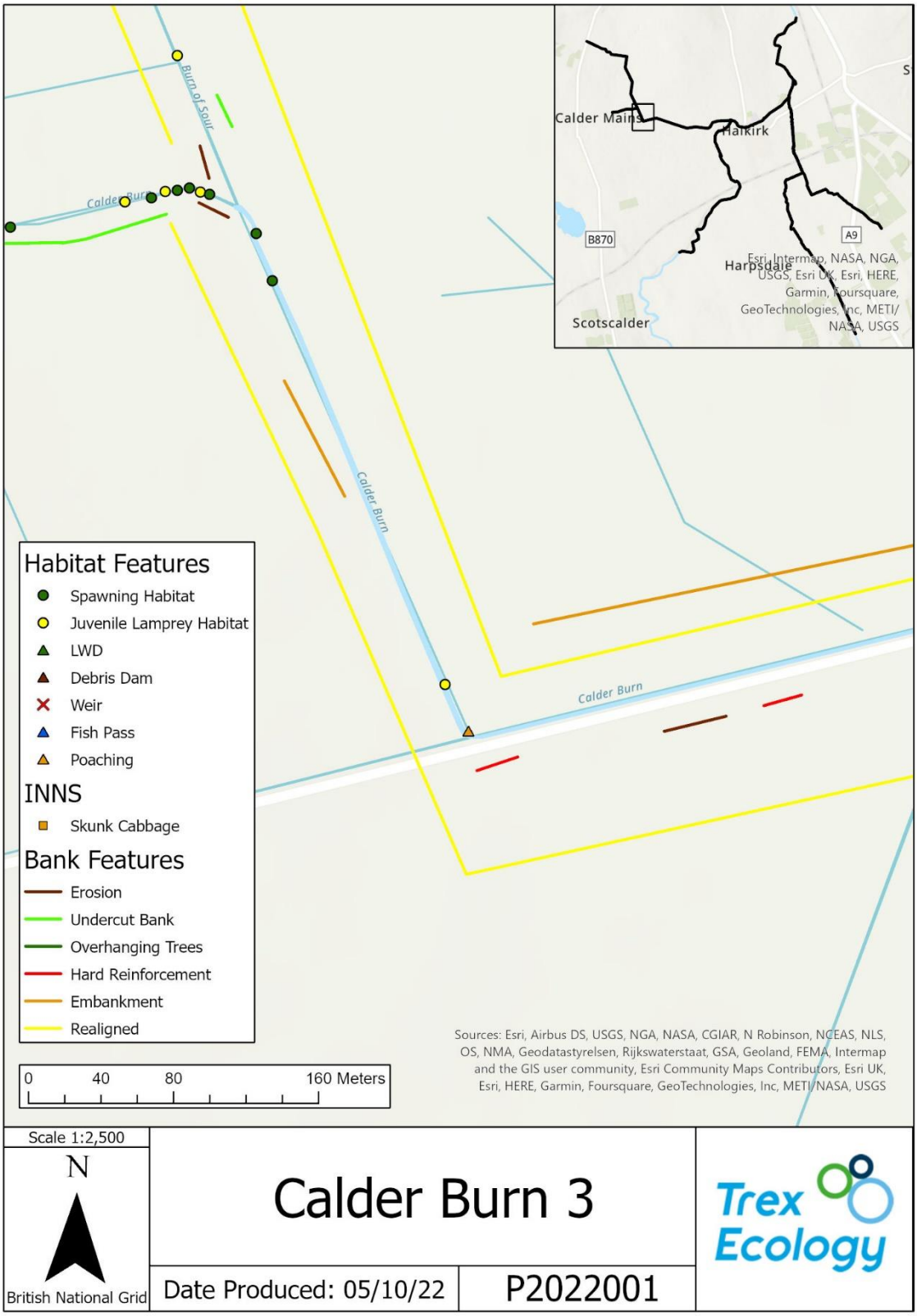
The maps for Calder Burn are set at a scale of 1:2,500.



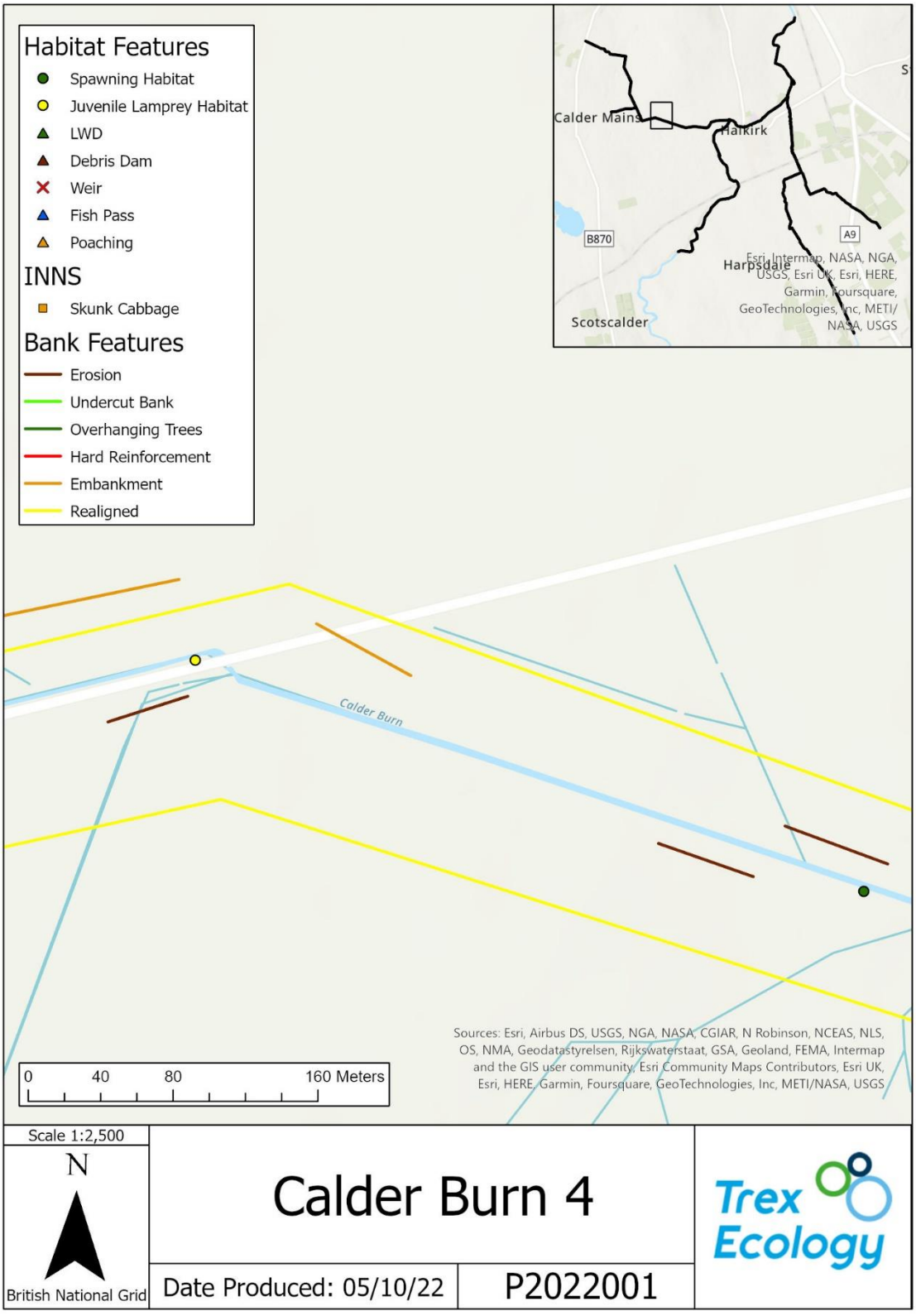
C1.12. Calder Burn, rapid survey, map 1



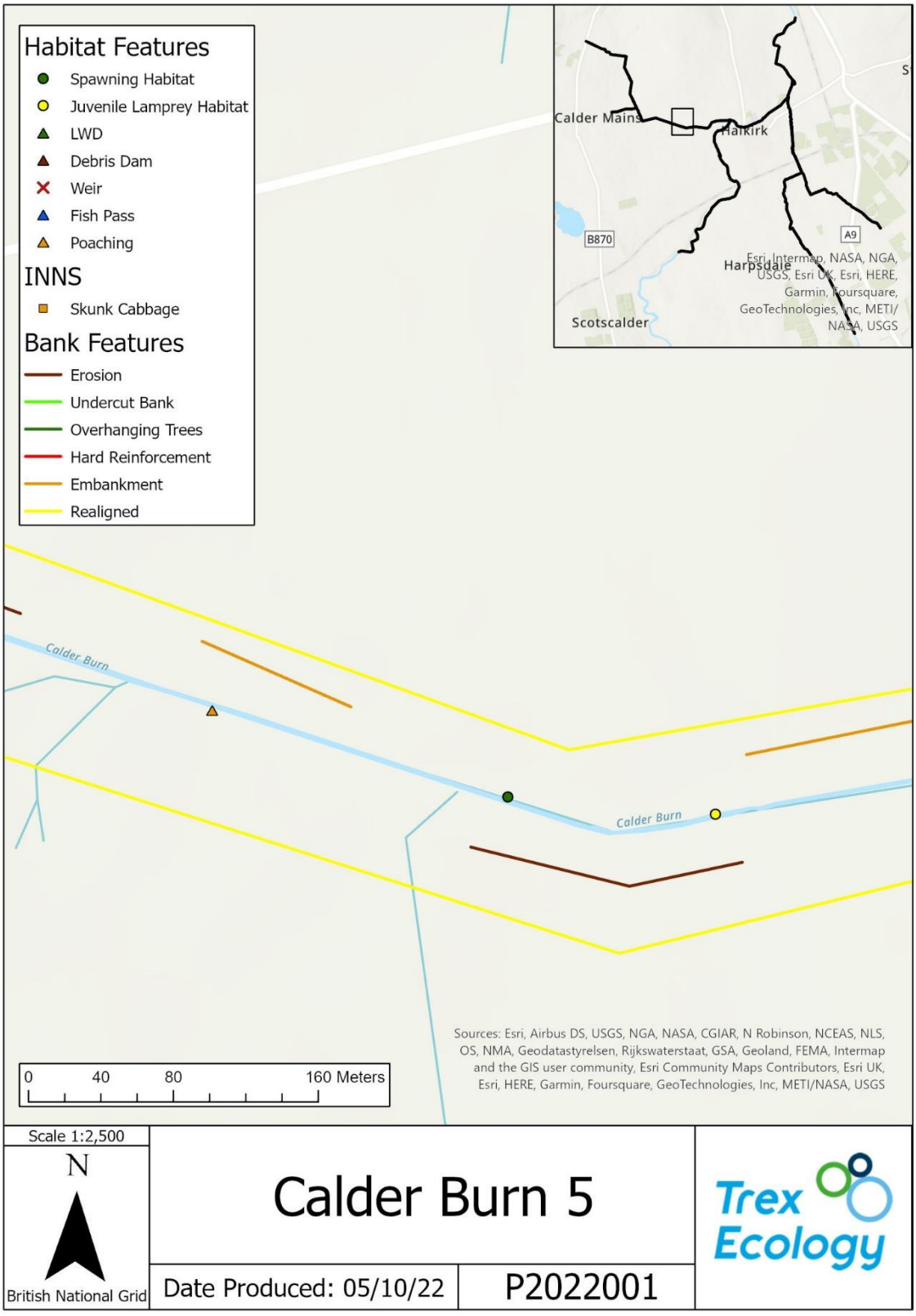
C1.13. Calder Burn, rapid survey, map 2



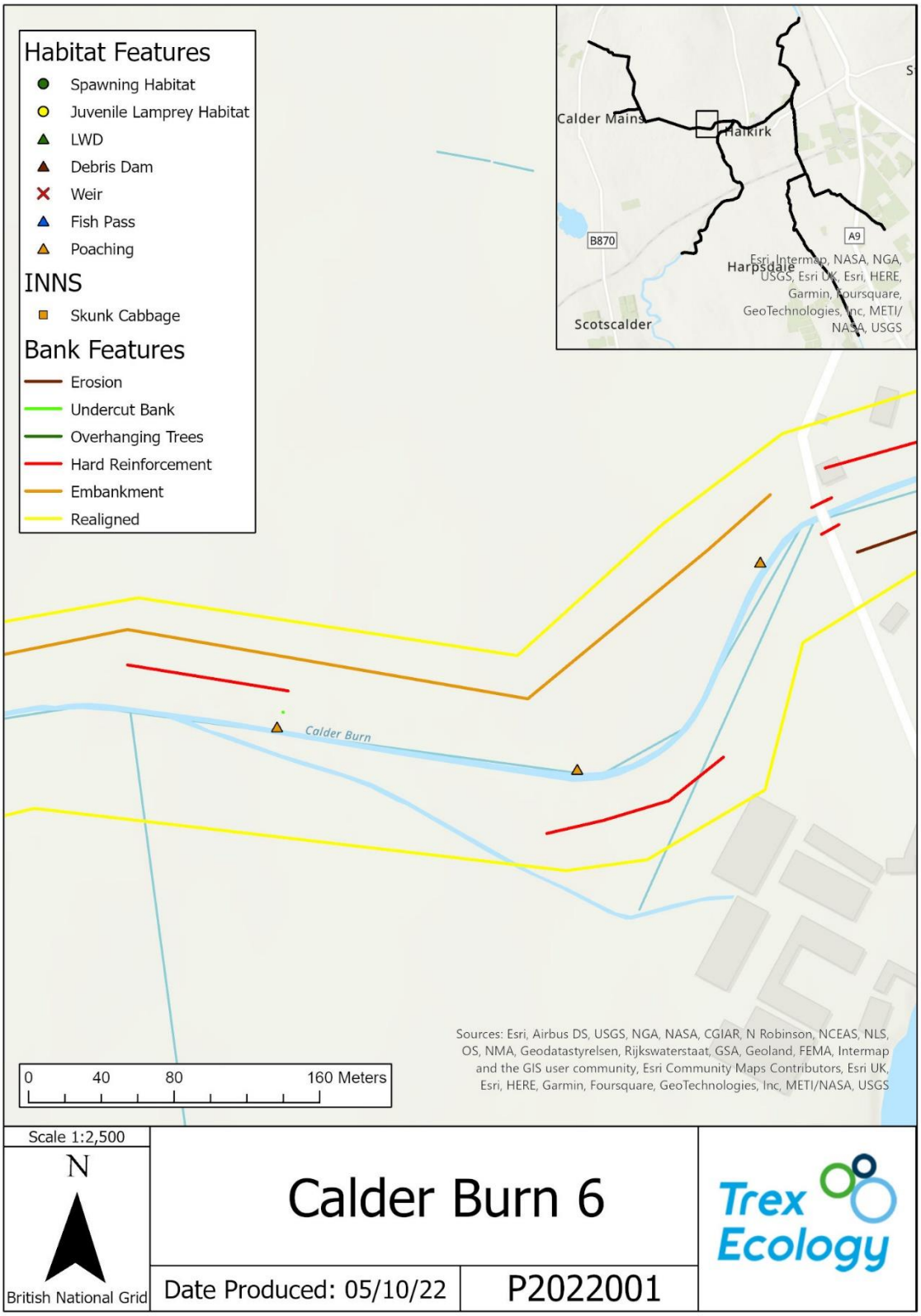
C1.14. Calder Burn, rapid survey, map 3



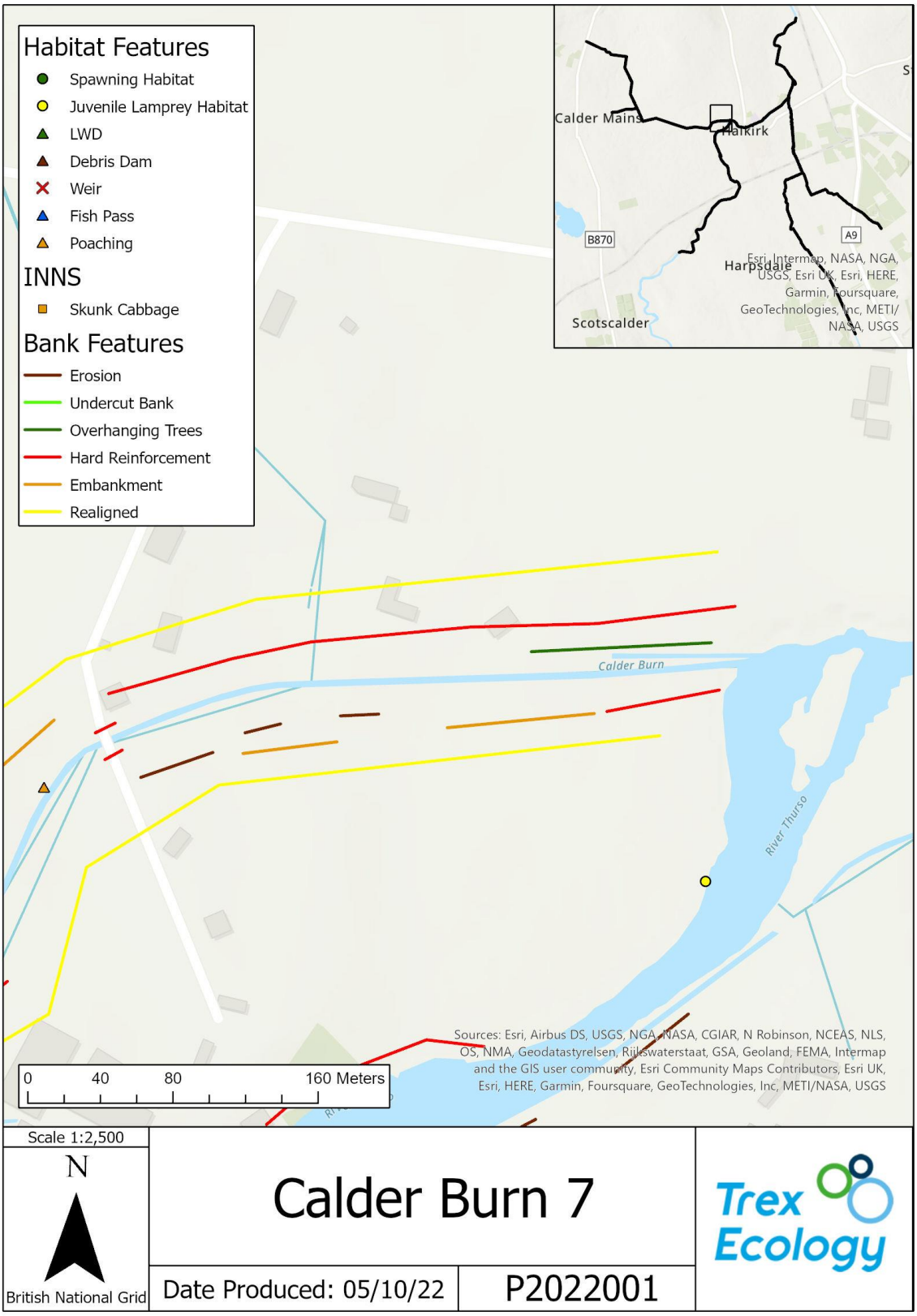
C1.15. Calder Burn, rapid survey, map 4



C1.16. Calder Burn, rapid survey, map 5



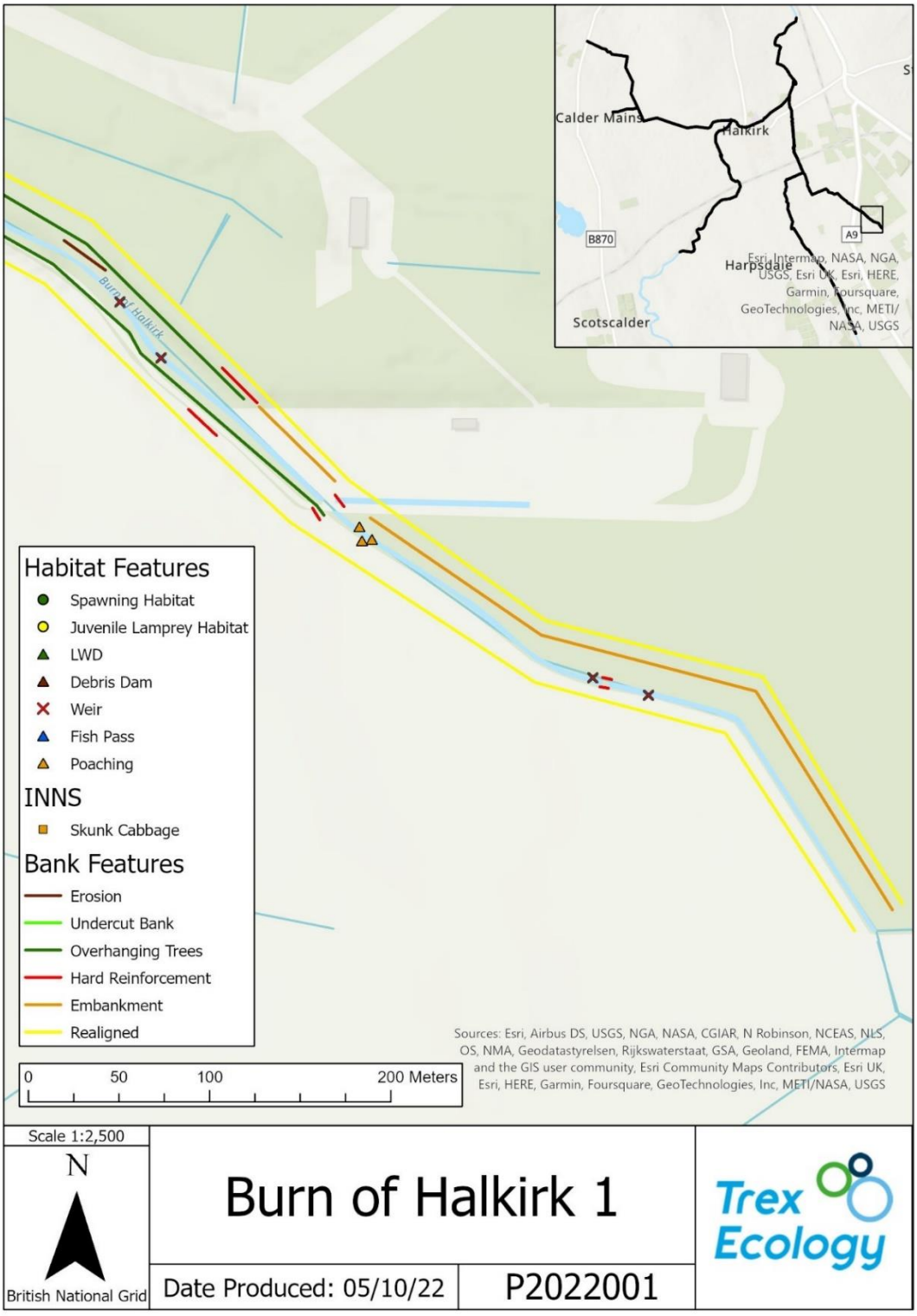
C1.17. Calder Burn, rapid survey, map 6



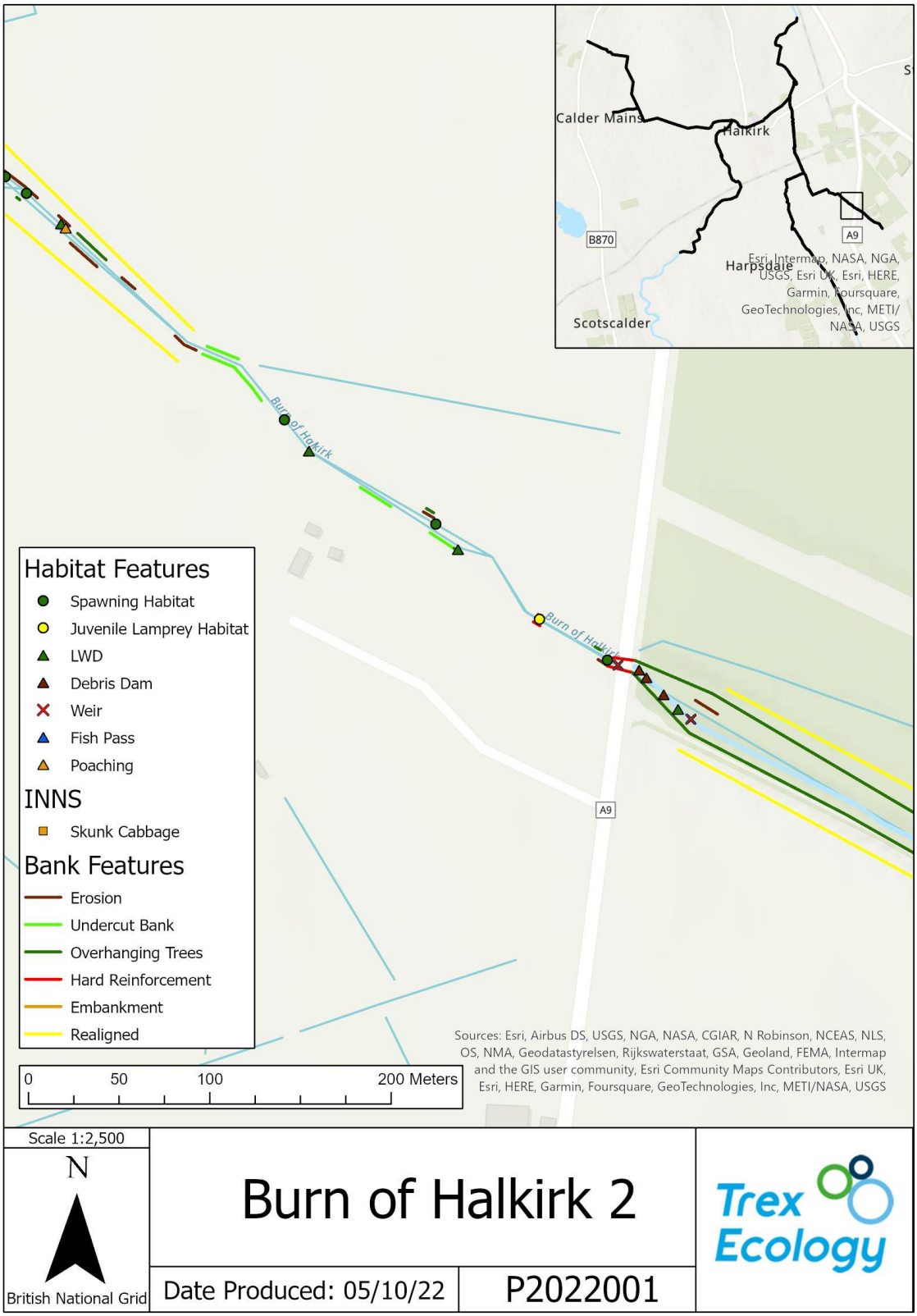
C1.18. Calder Burn, rapid survey, map 7

C1.5 Burn of Halkirk

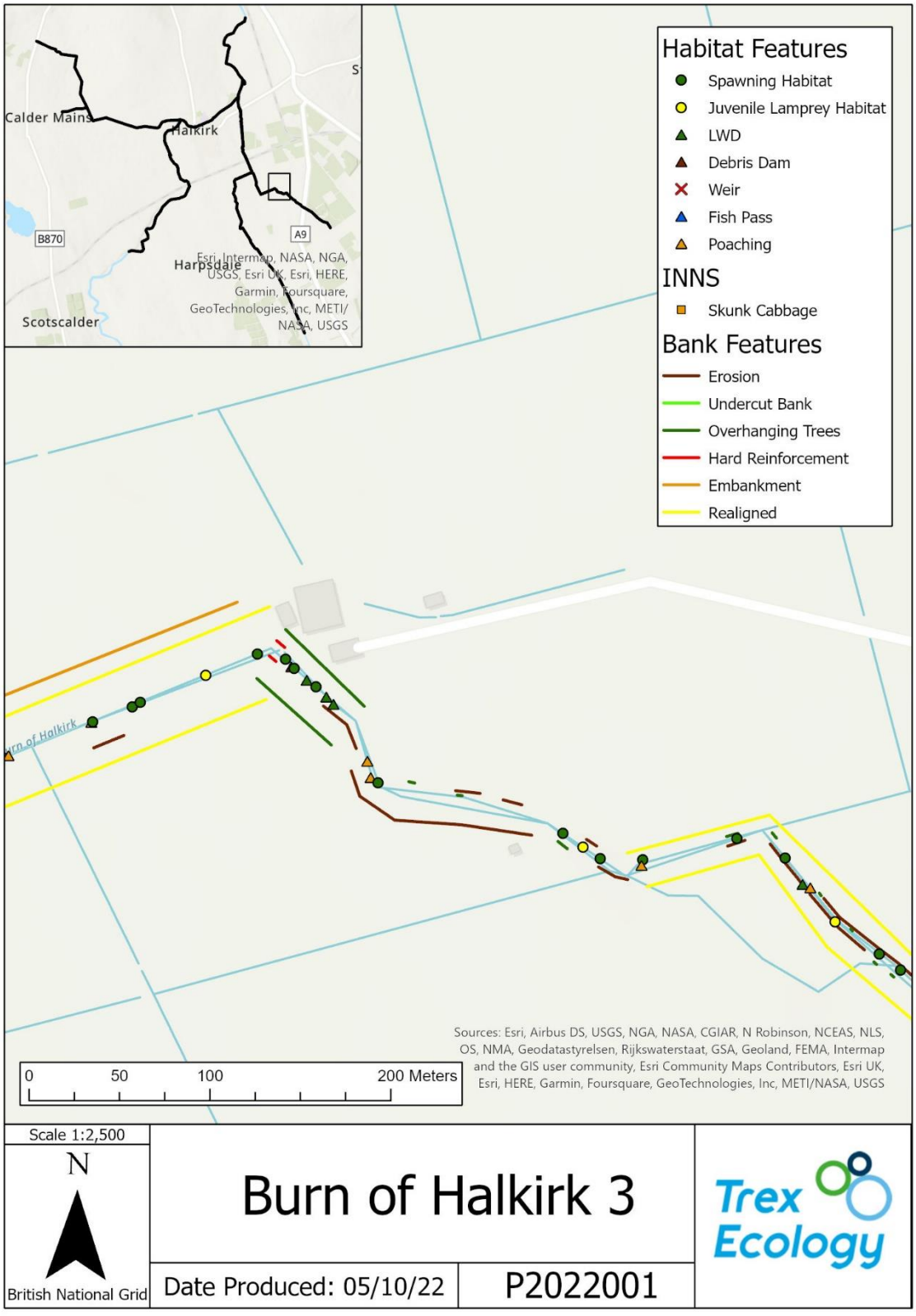
The maps for Burn of Halkirk are set at a scale of 1:2,500.



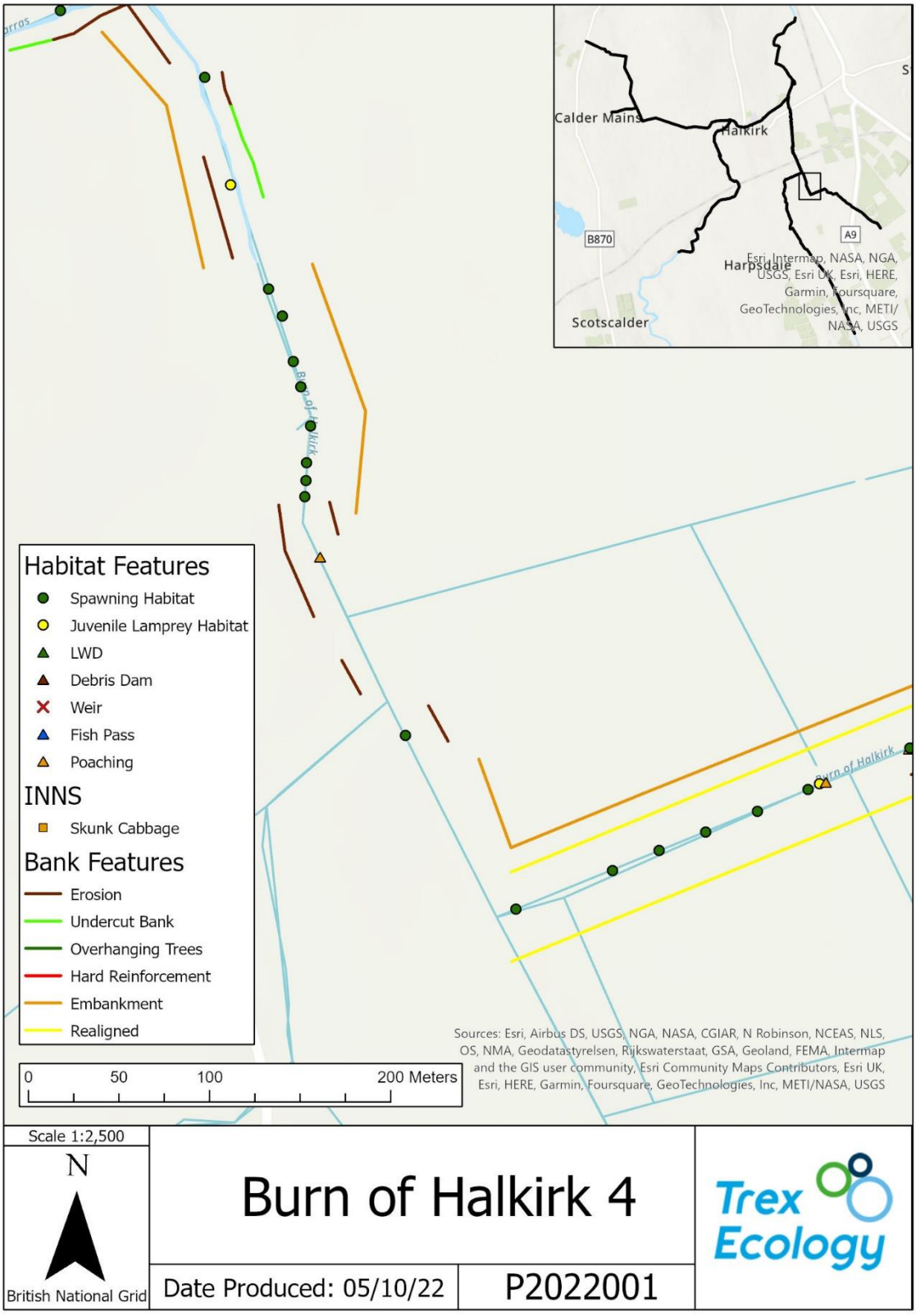
C1.19. Burn of Halkirk, rapid survey, map 1



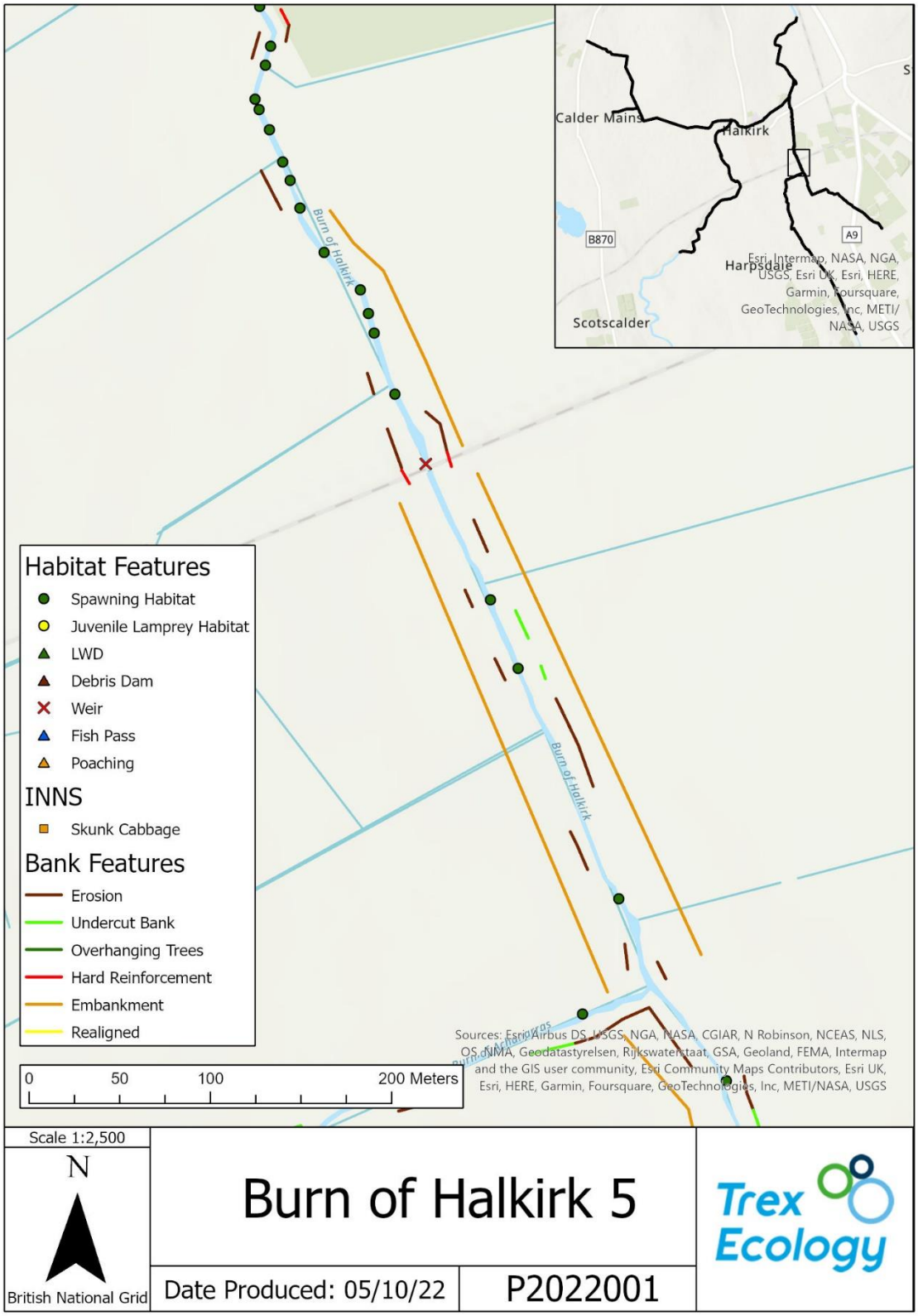
C1.20. Burn of Halkirk, rapid survey, map 2



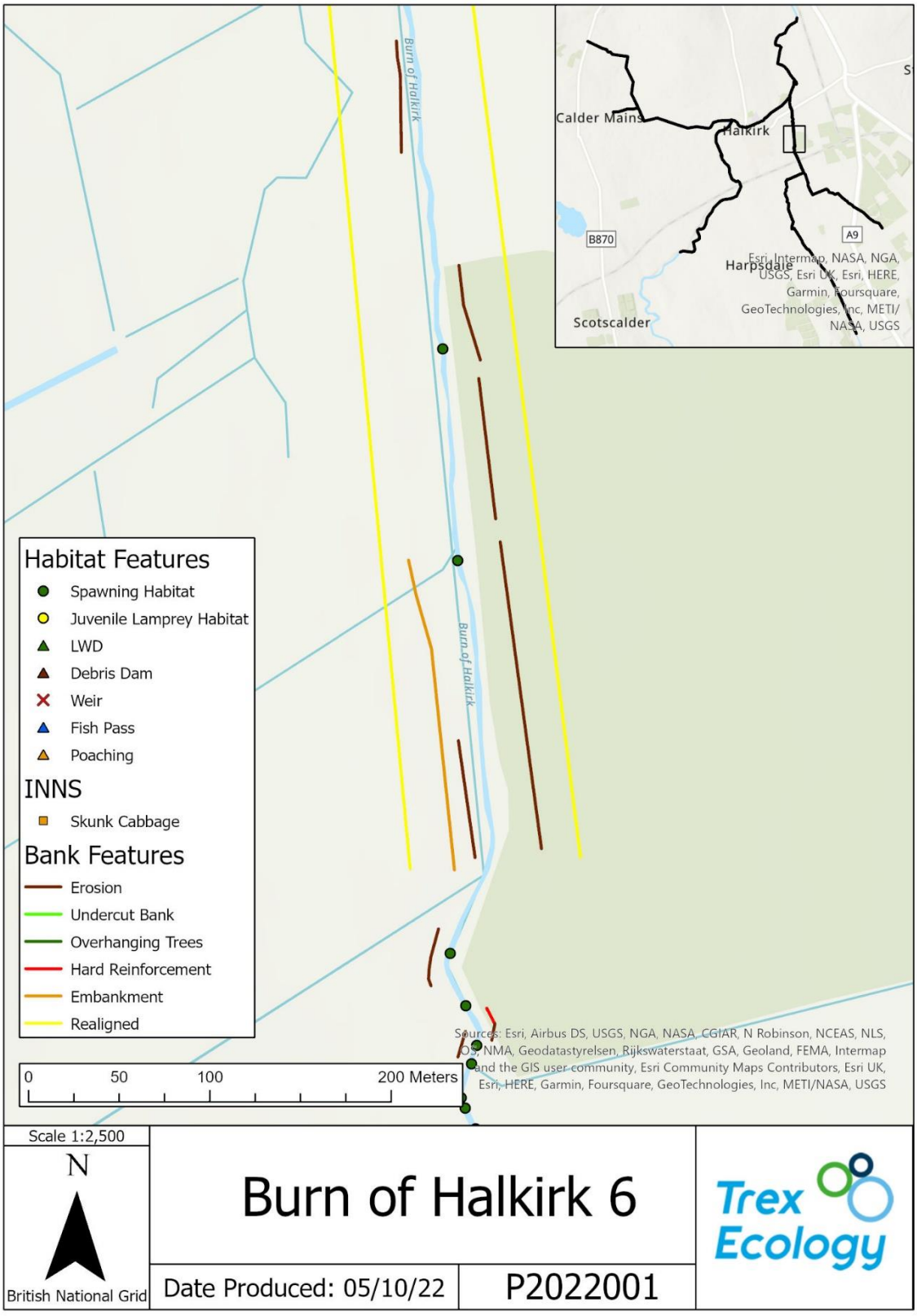
C1.21. Burn of Halkirk, rapid survey, map 3



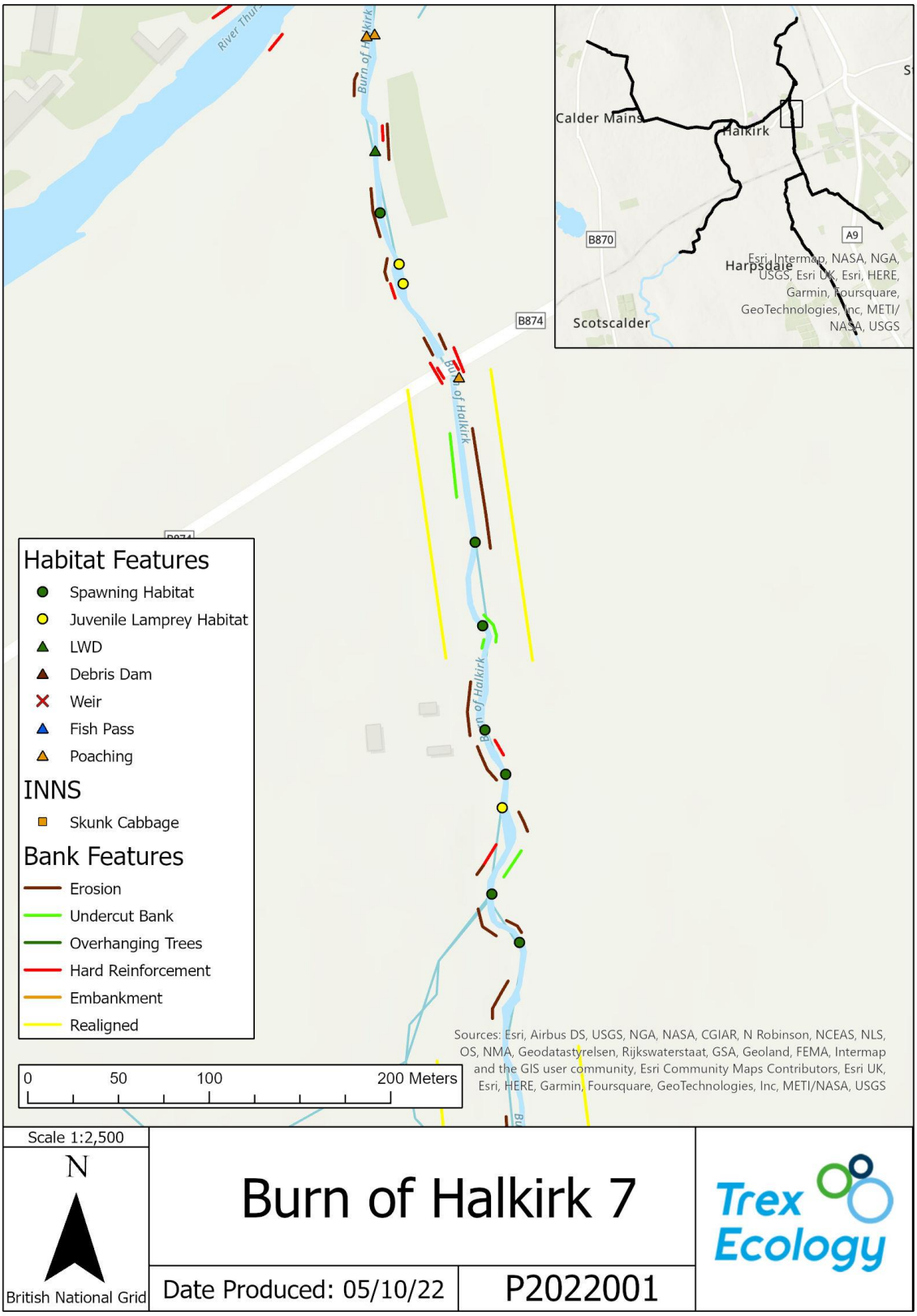
C1.22. Burn of Halkirk, rapid survey, map 4



C1.23. Burn of Halkirk, rapid survey, map 5



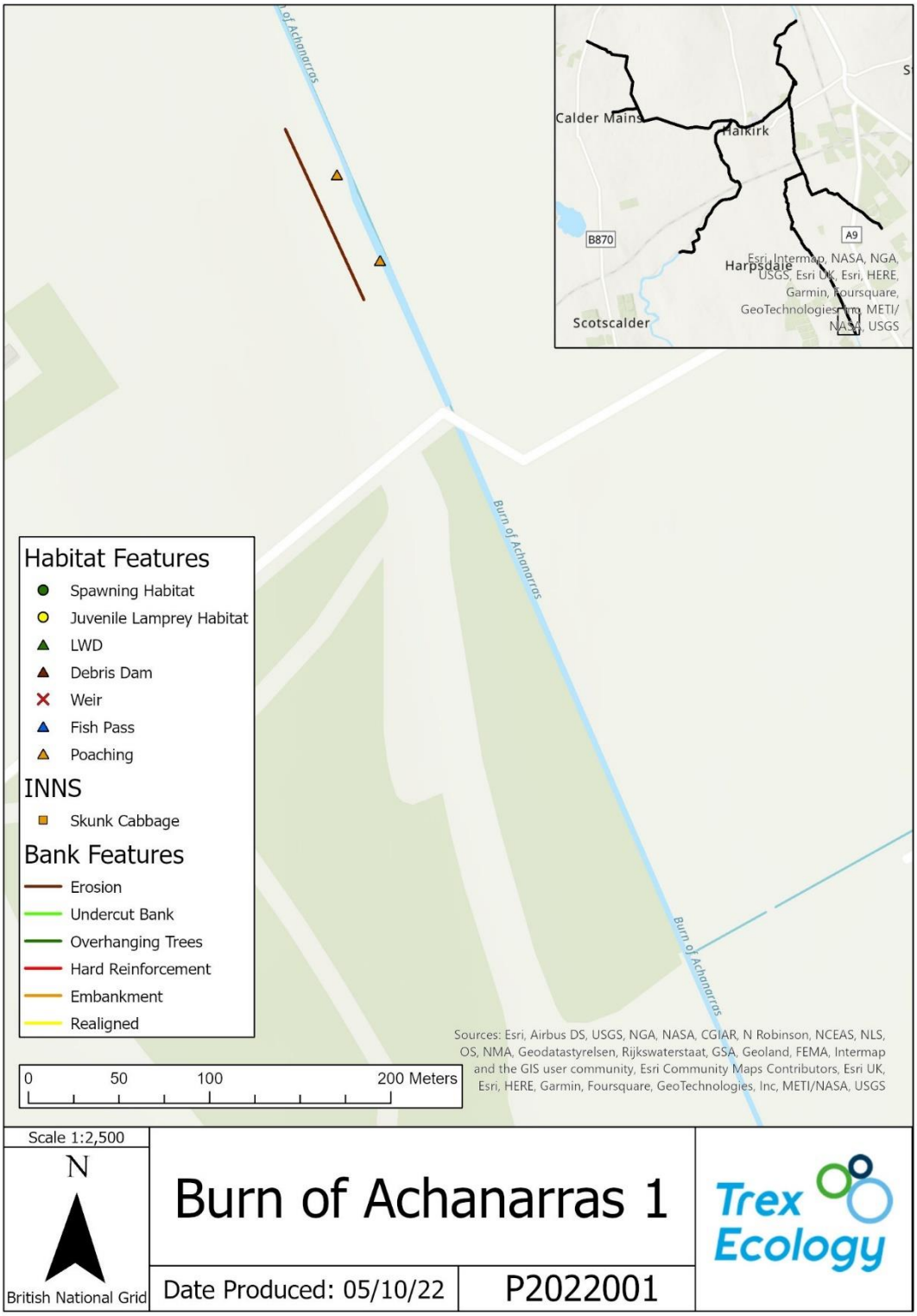
C1.24. Burn of Halkirk, rapid survey, map 6



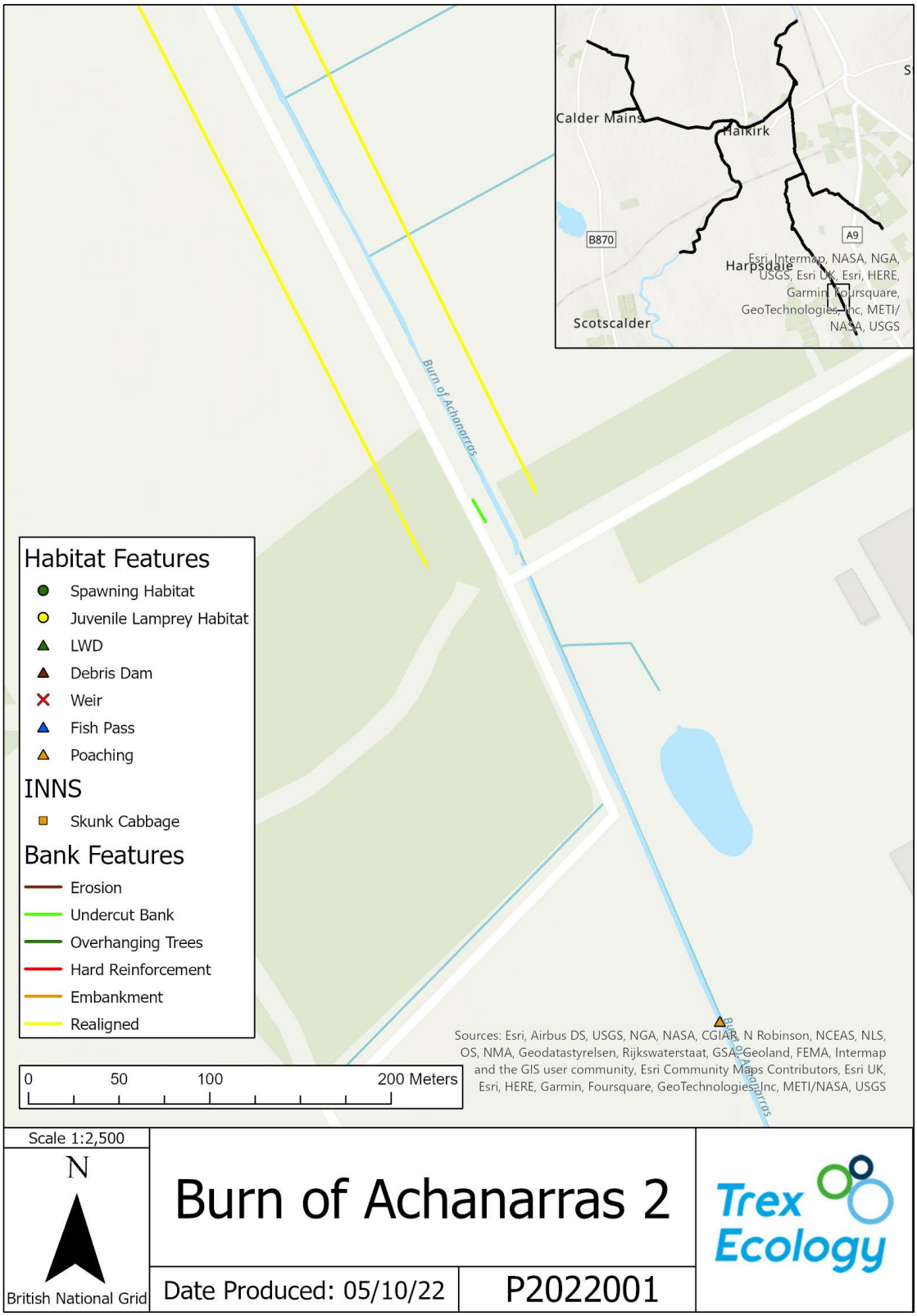
C1.25. Burn of Halkirk, rapid survey, map 7

C1.6 Burn of Achanarras

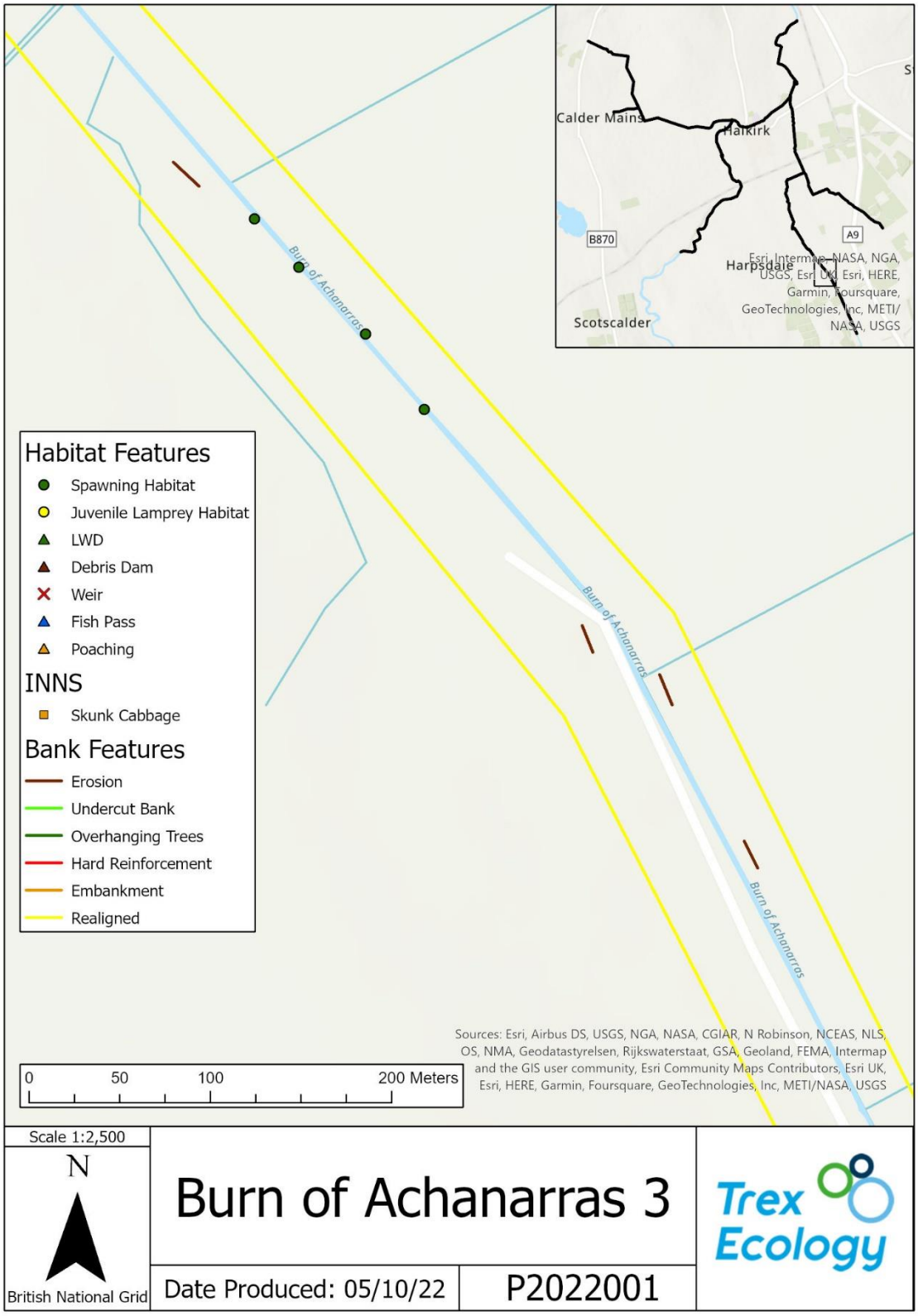
The maps for Burn of Achanarras are set at a scale of 1:2,500.



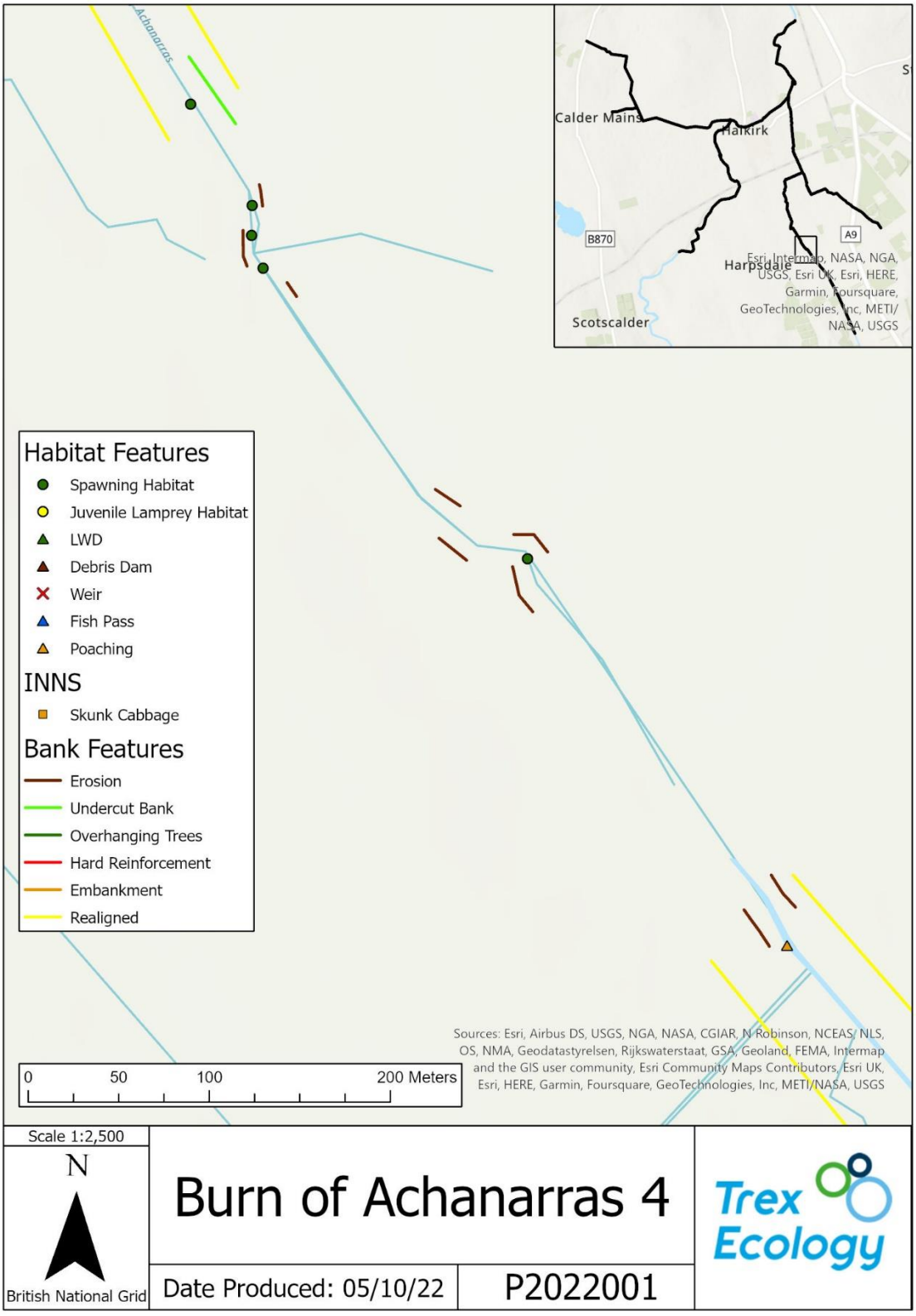
C1.26. Burn of Achanarras, rapid survey, map 1



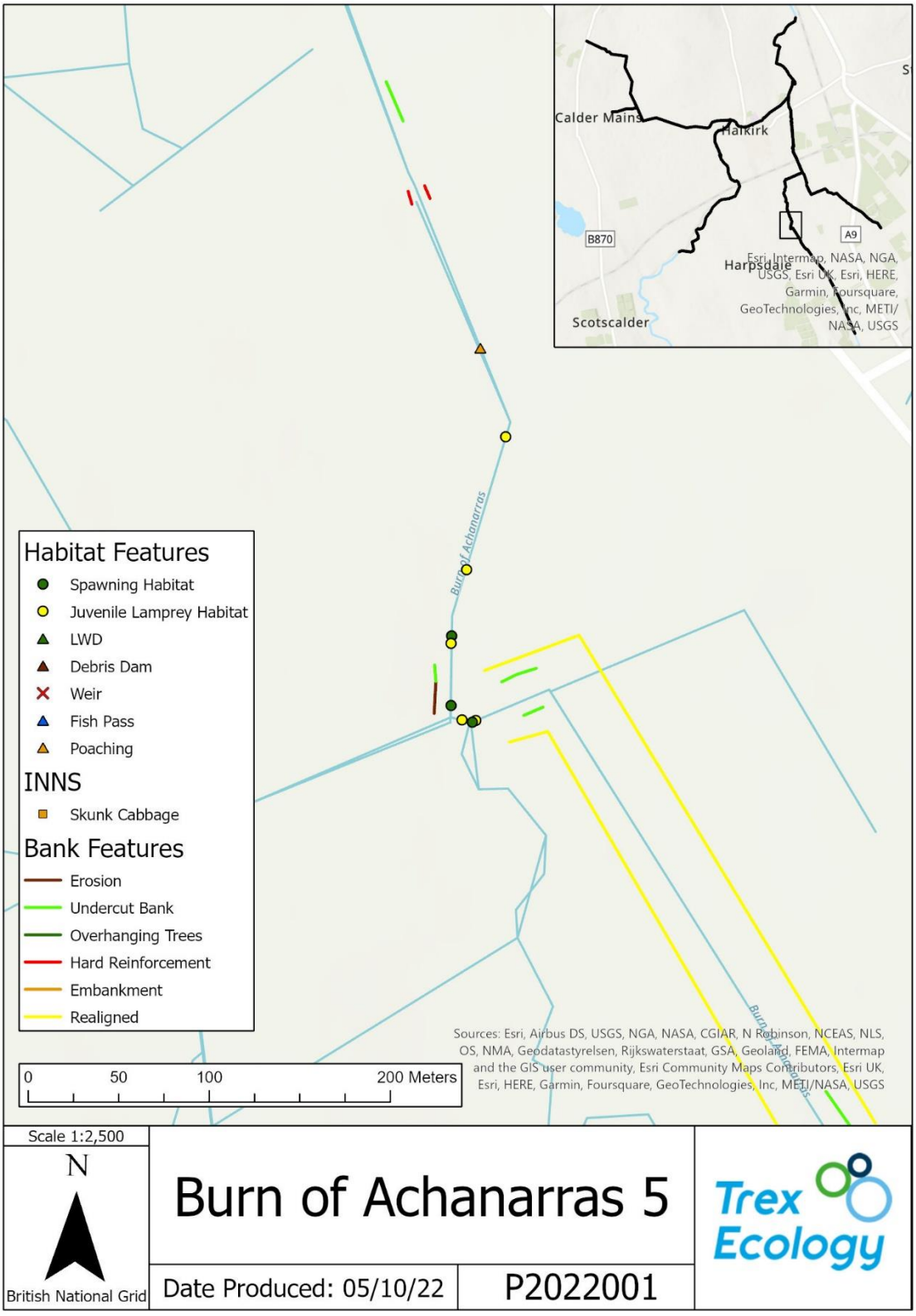
C1.27. Burn of Achanarras, rapid survey, map 2



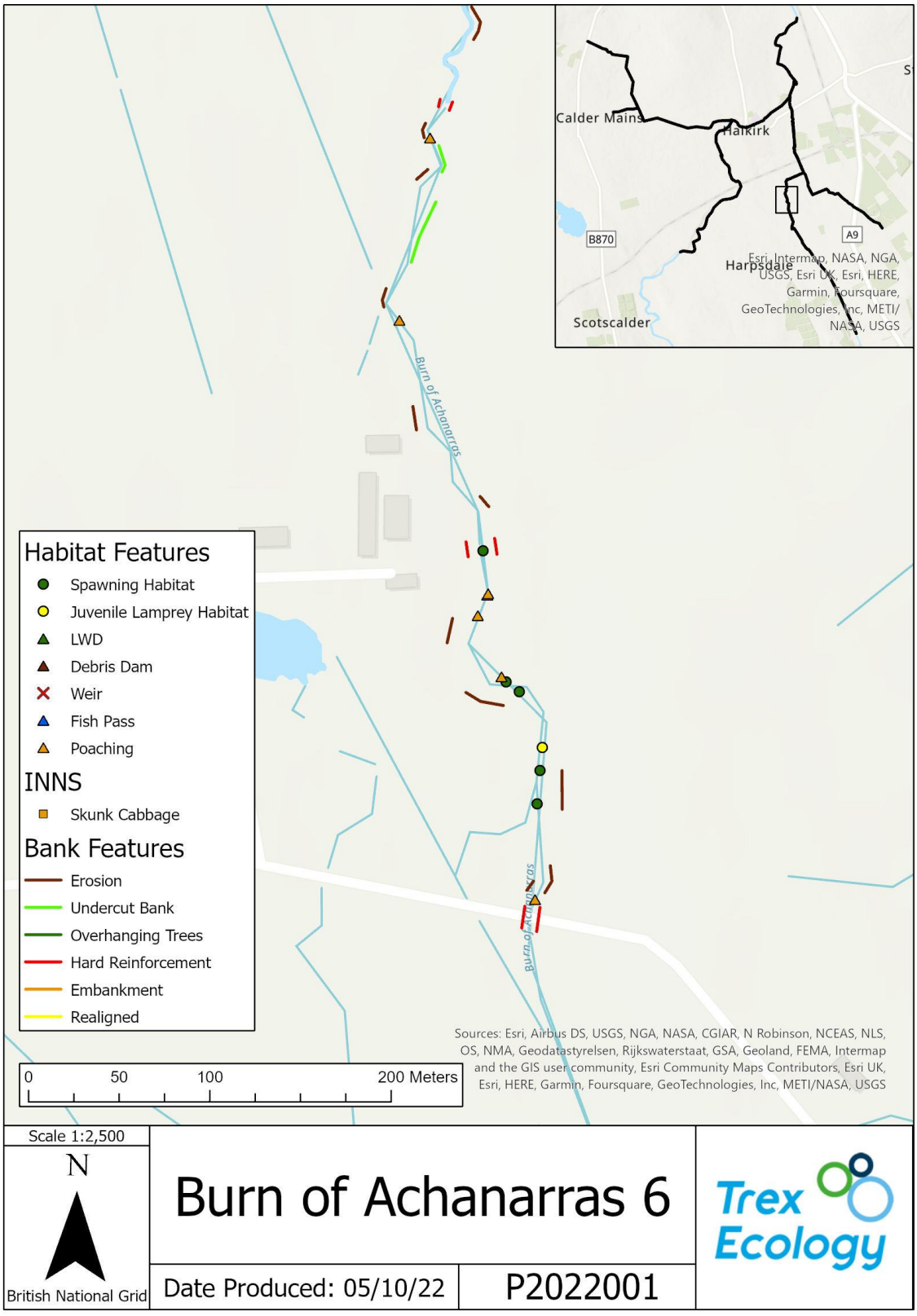
C1.28. Burn of Achanarras, rapid survey, map 3



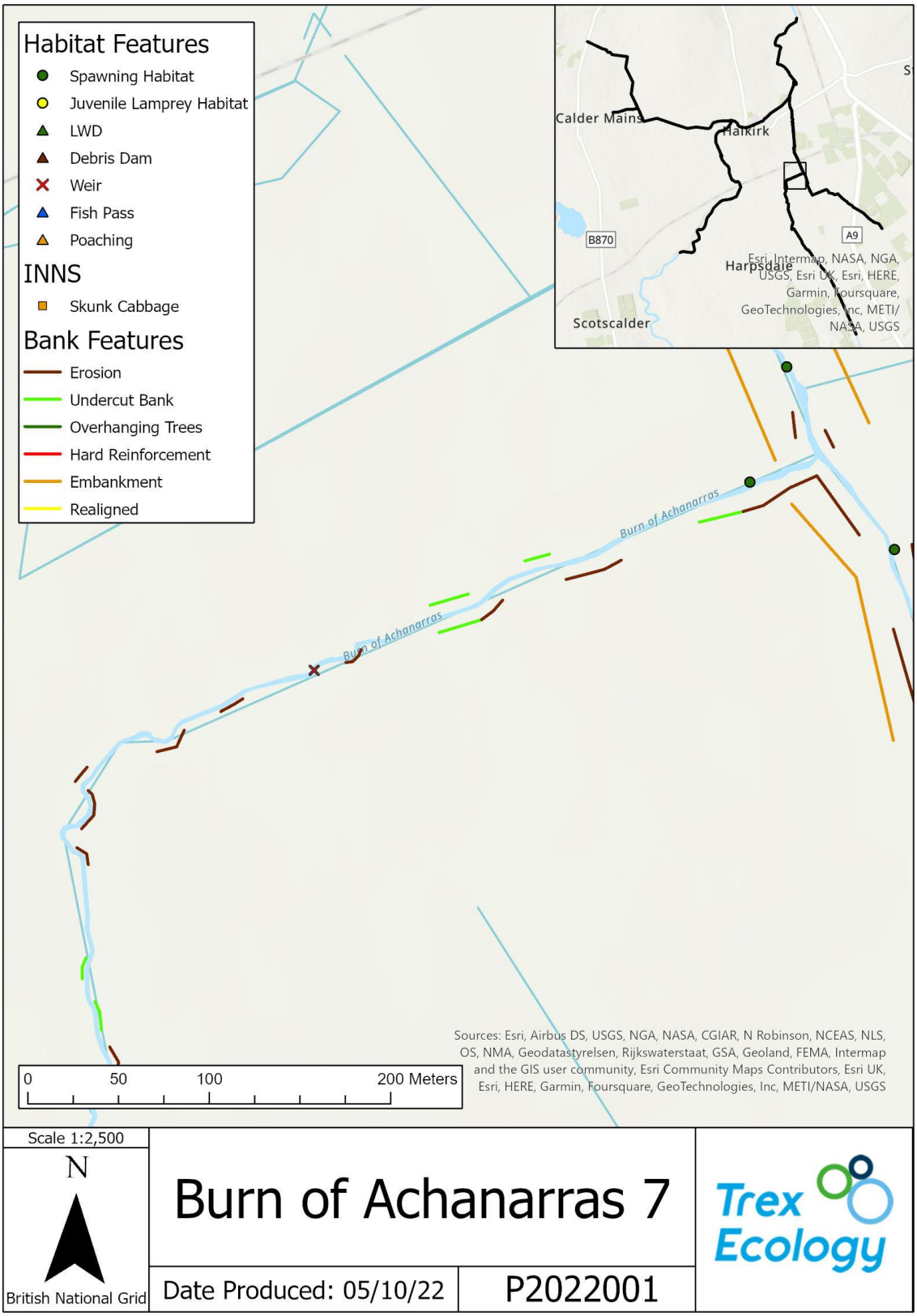
C1.29. Burn of Achanarras, rapid survey, map 4



C1.30. Burn of Achanarras, rapid survey, map 5



C1.31. Burn of Achanarras, rapid survey, map 6



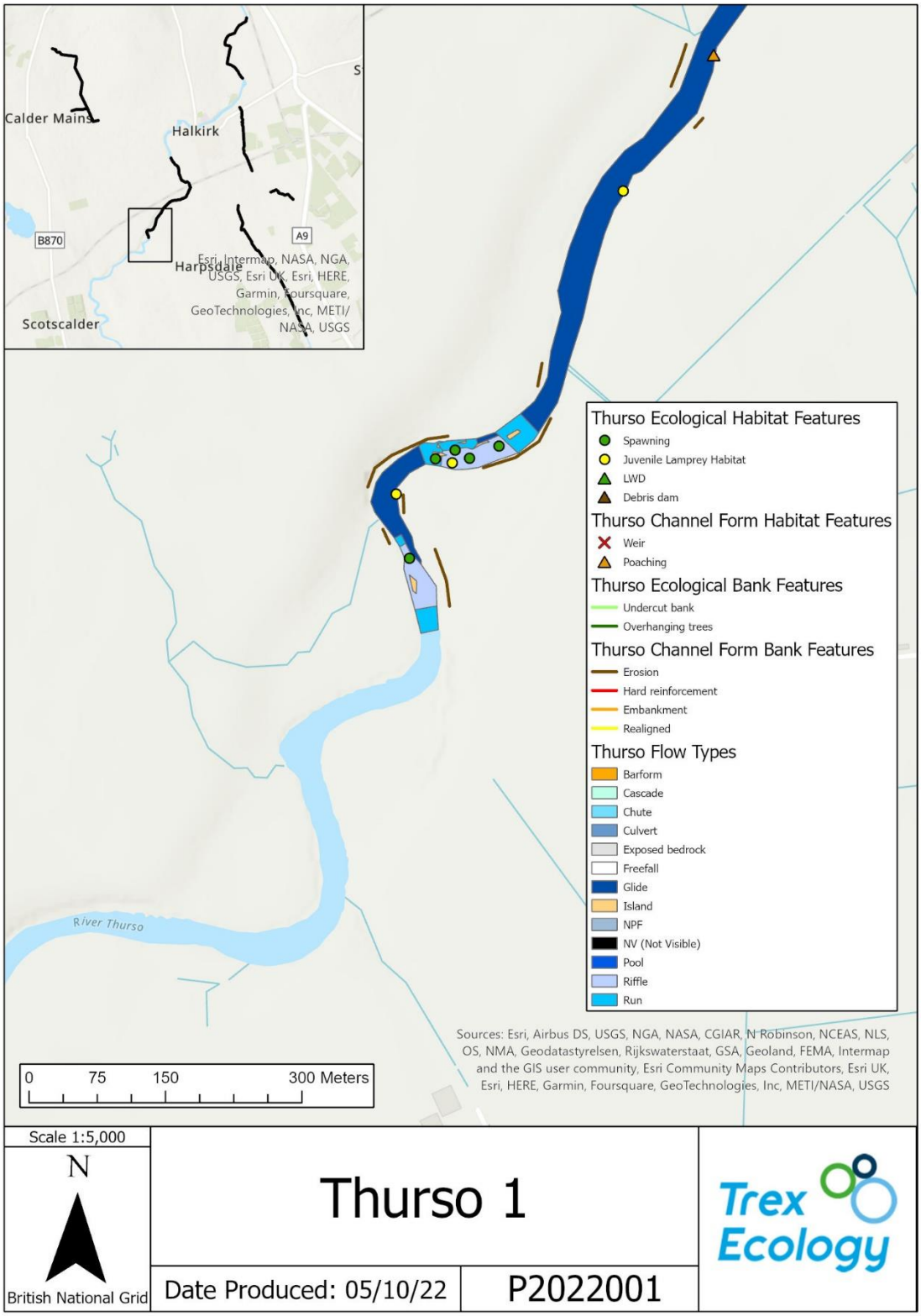
C1.32. Burn of Achanarras, rapid survey, map 7

C2 Thurso Catchment Detailed Walkovers

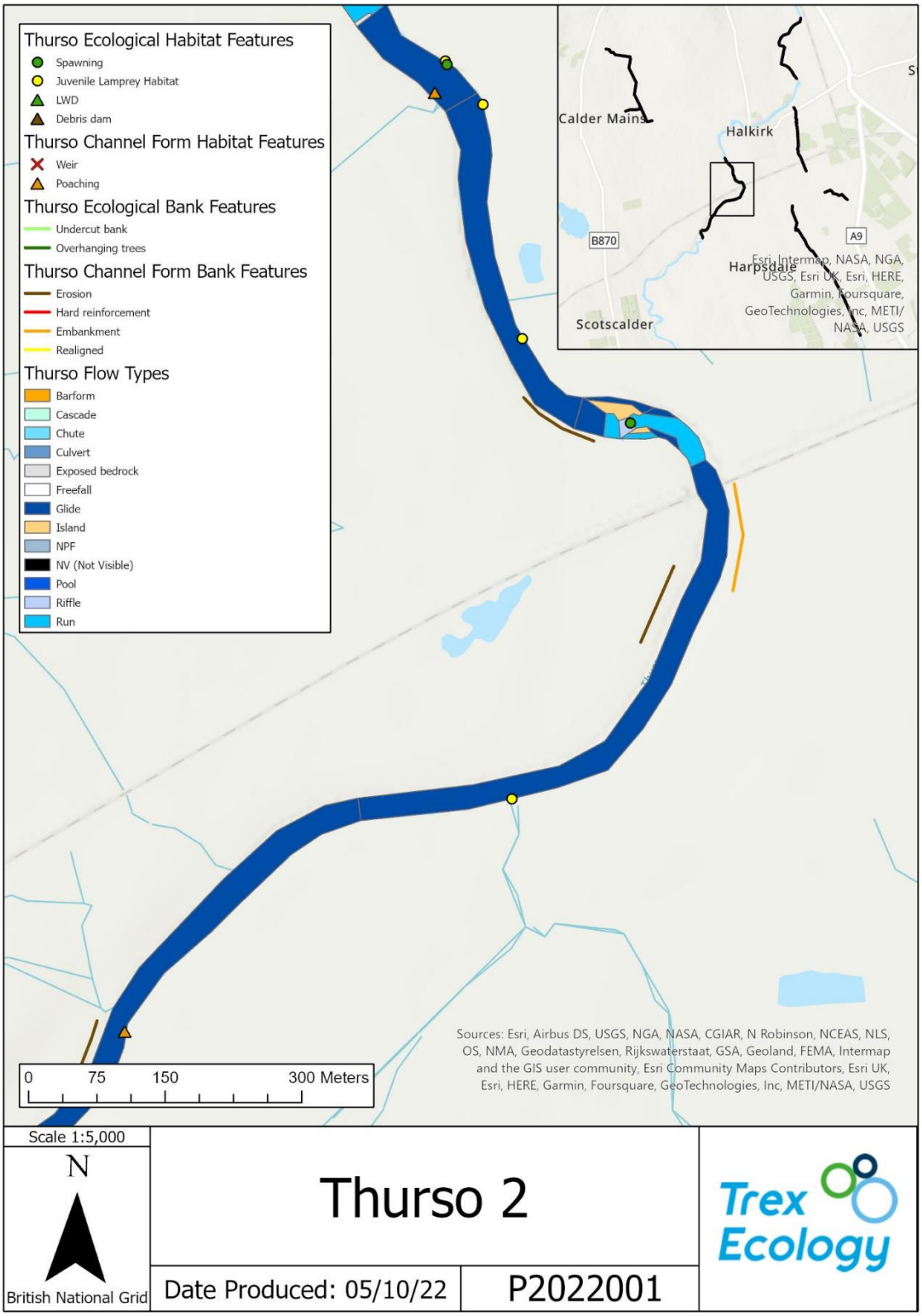
Presented in Appendix C2 are the results of the detailed walkovers for the Thurso Catchment.

C2.1 River Thurso

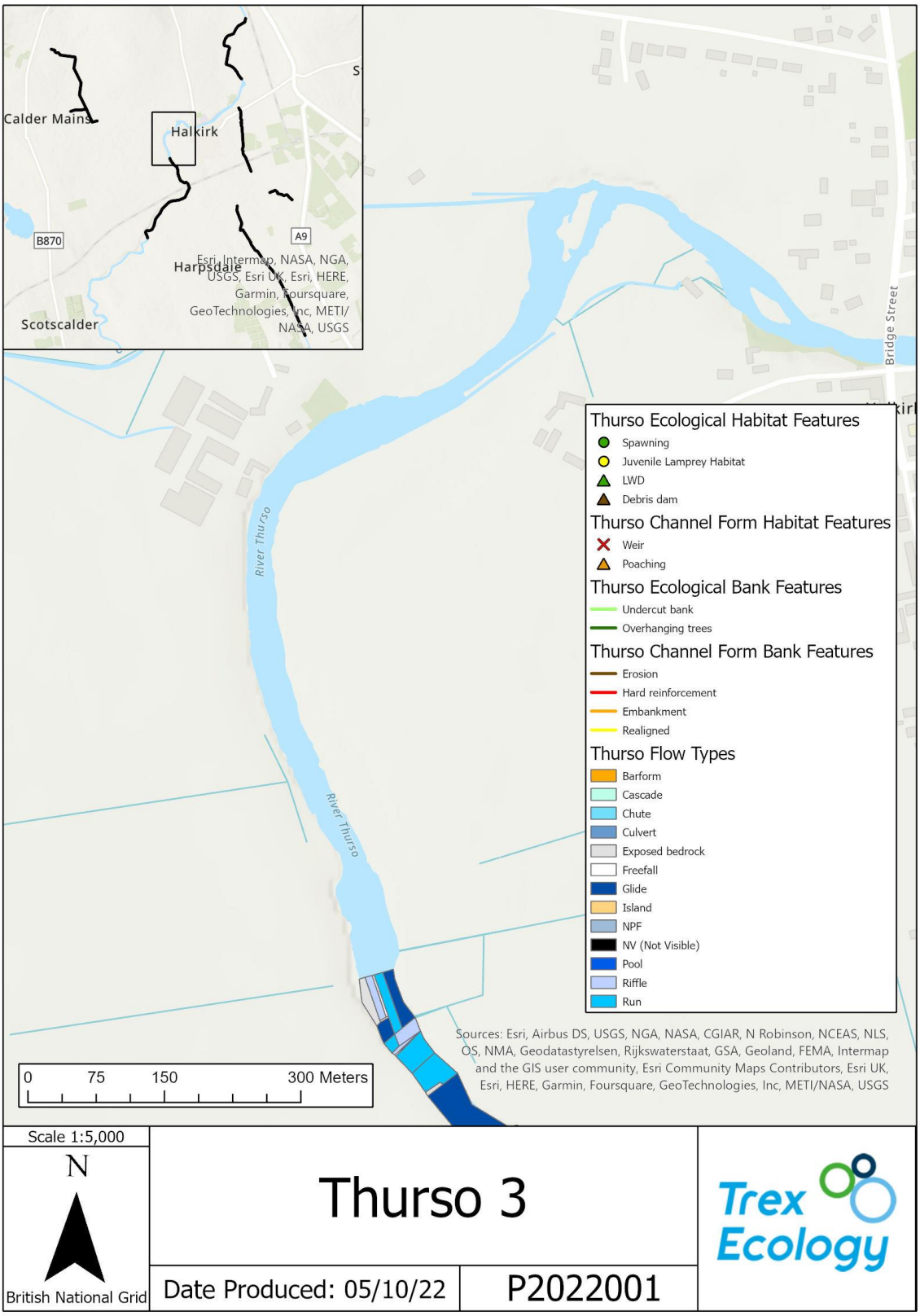
The maps for the River Thurso are set at a scale of 1:5,000.



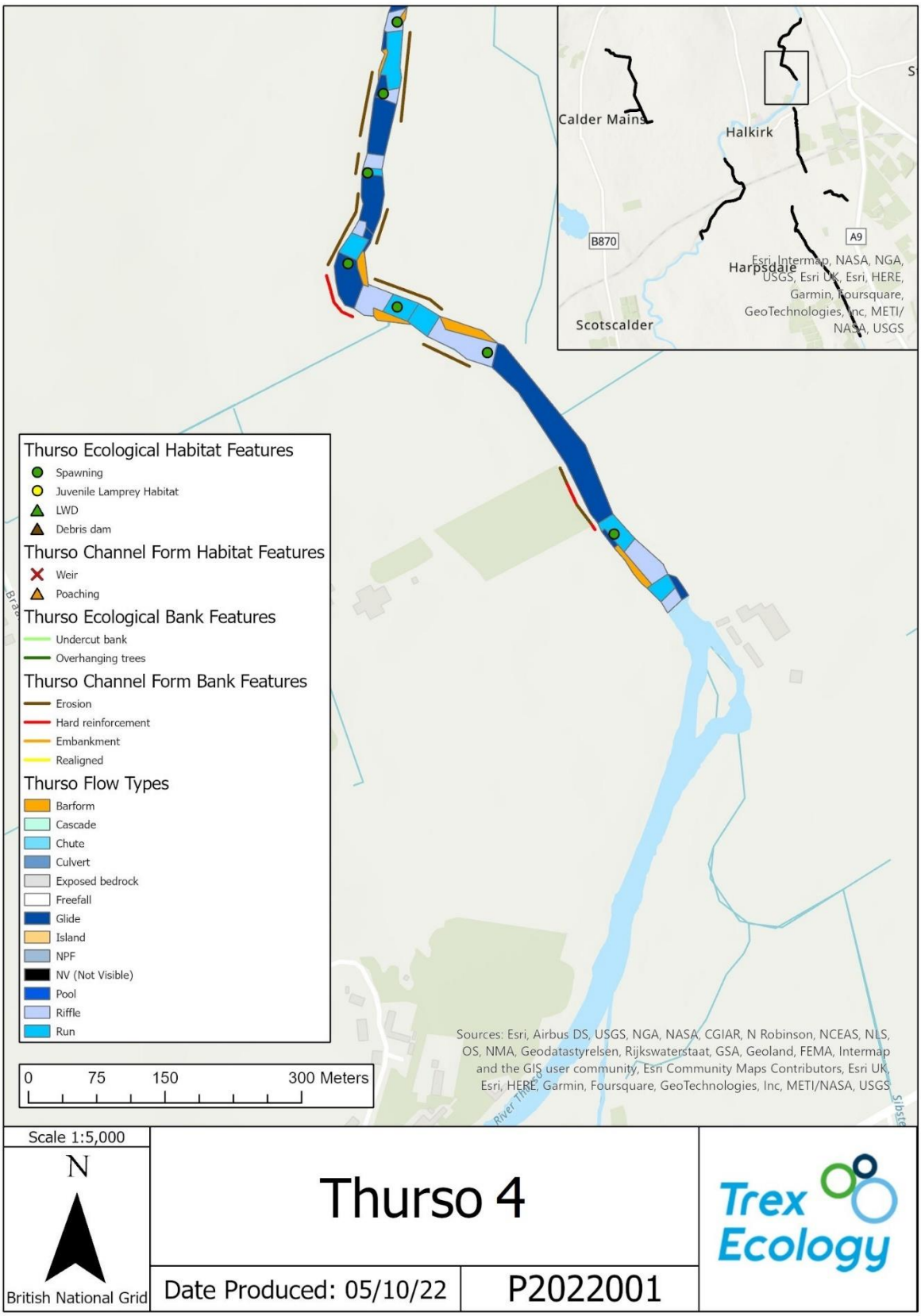
C2.1. River Thurso, detailed walkover, map 1



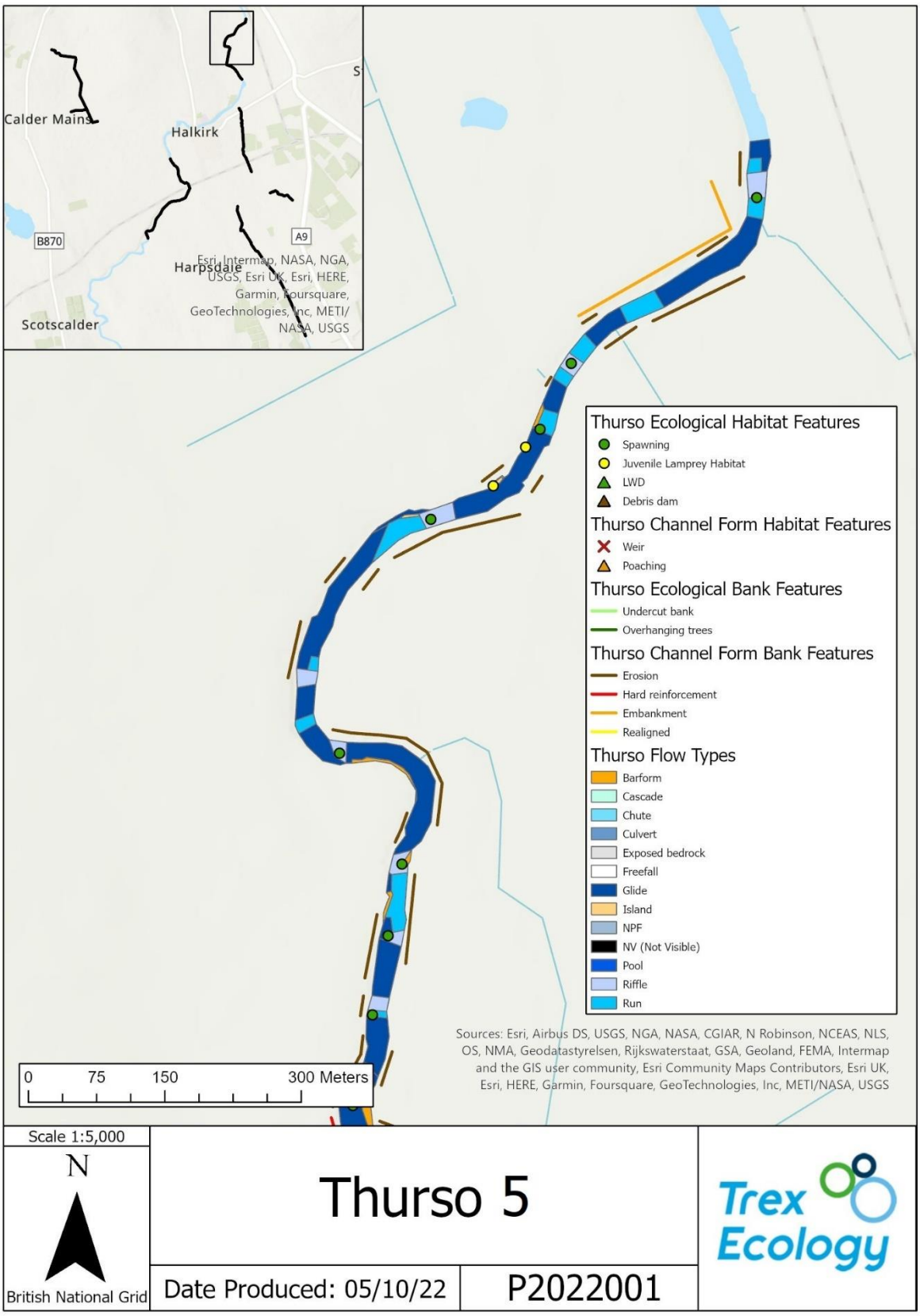
C2.2. River Thurso, detailed walkover, map 2



C2.3. River Thurso, detailed walkover, map 3



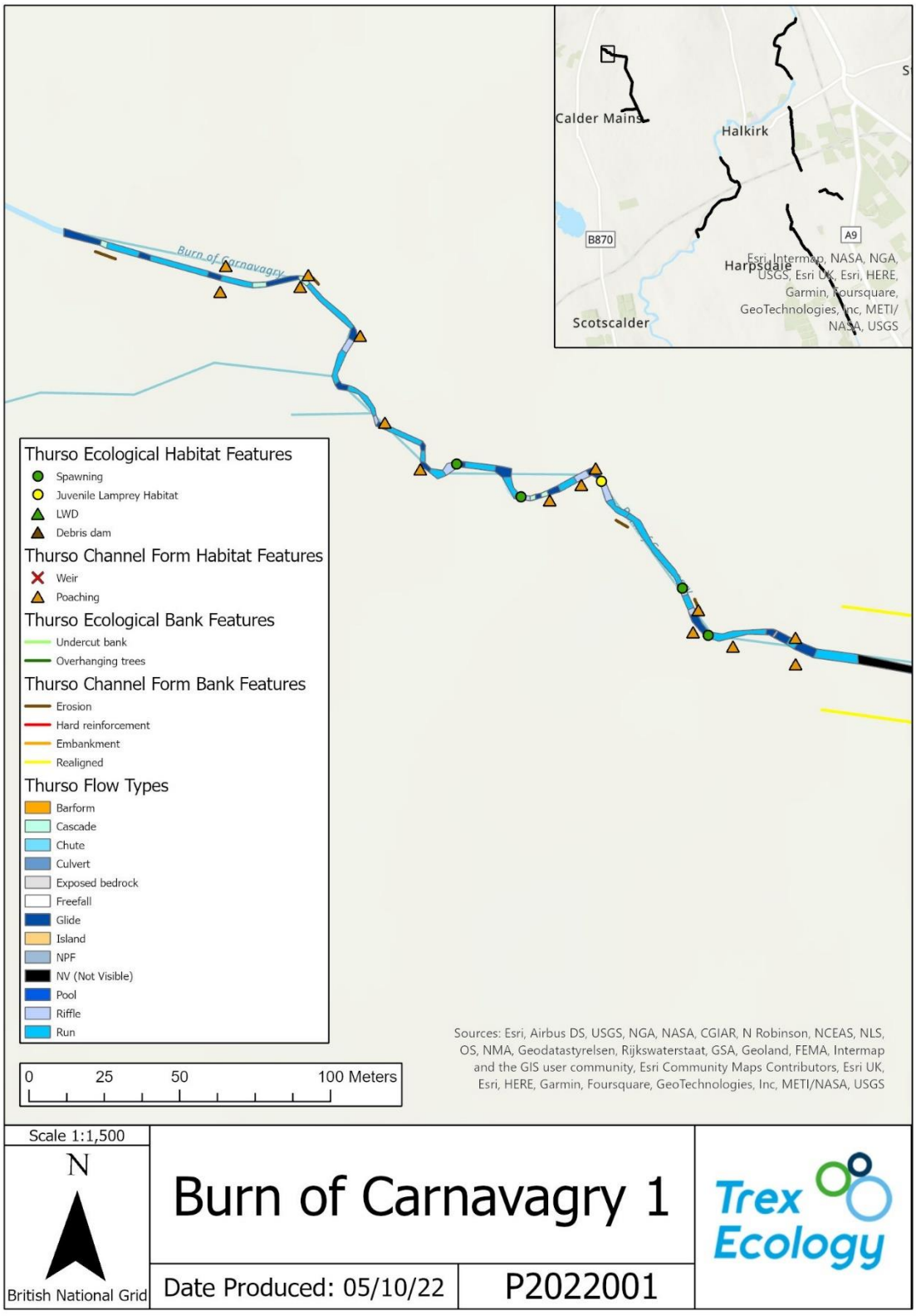
C2.4. River Thurso, detailed walkover, map 4



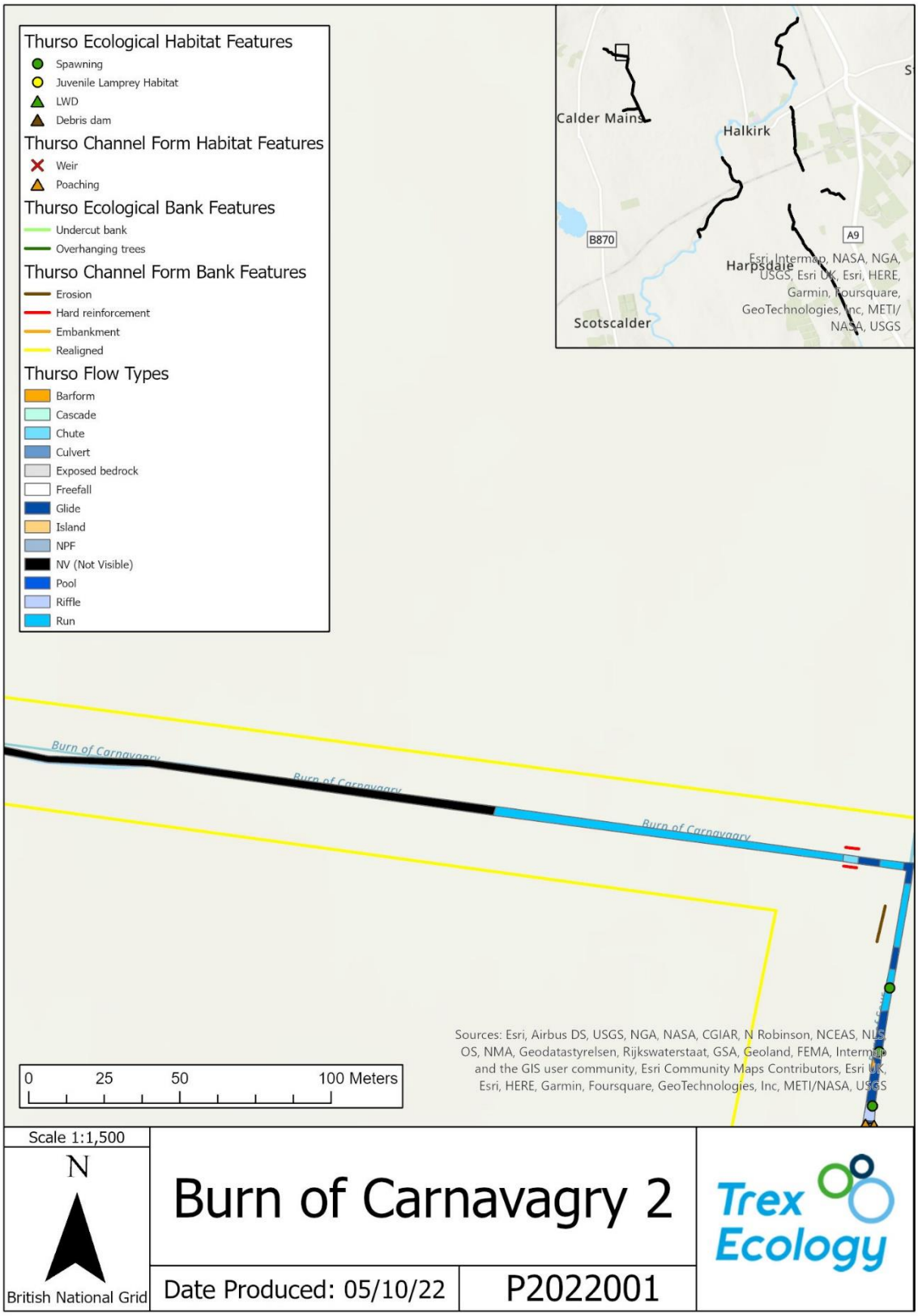
C2.5. River Thurso, detailed walkover, map 5

C2.2 Burn of Carnavagry

The maps for Burn of Carnavagry are set at a scale of 1:1,500.



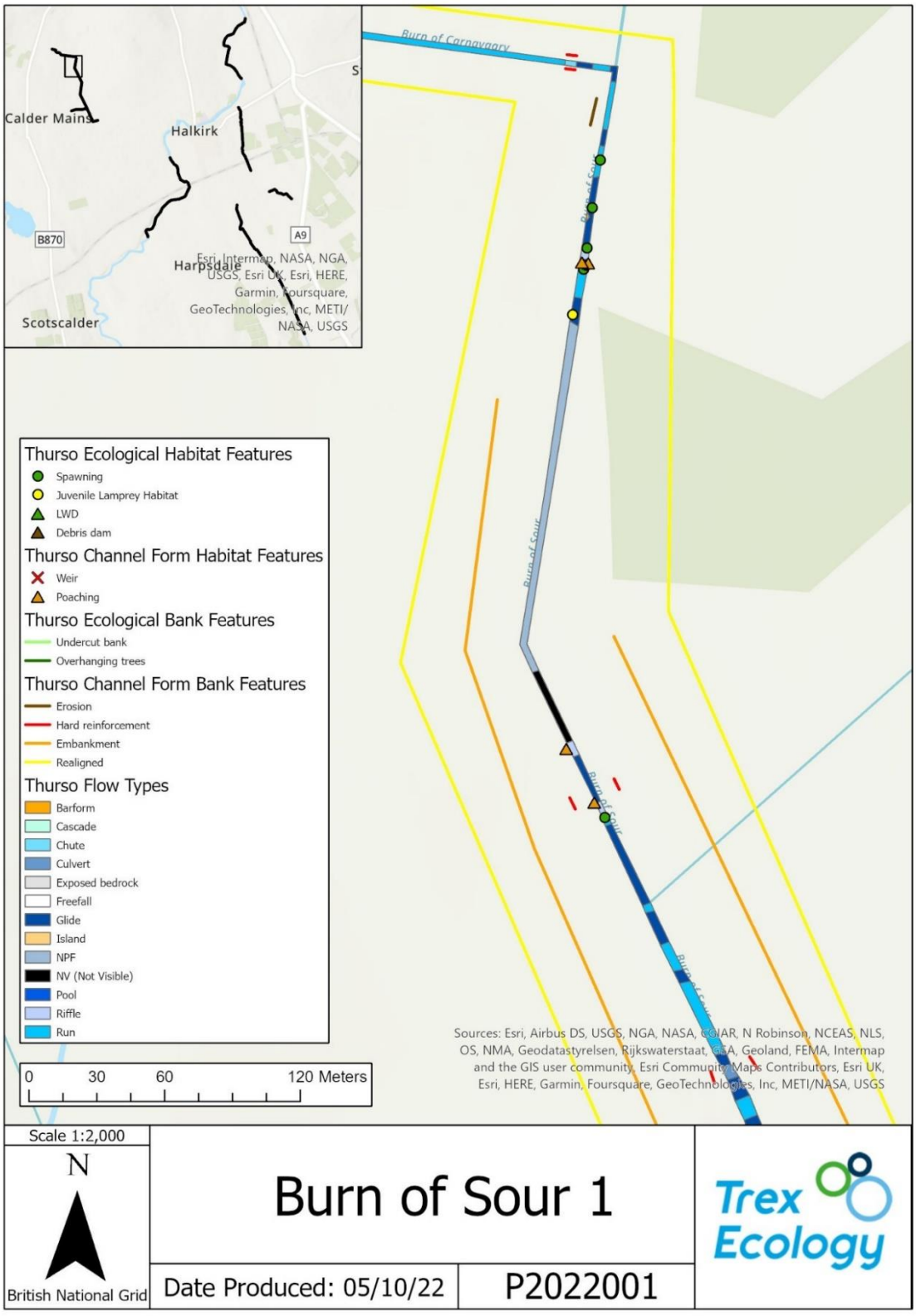
C2.6. Burn of Carnavagry, detailed walkover, map 1



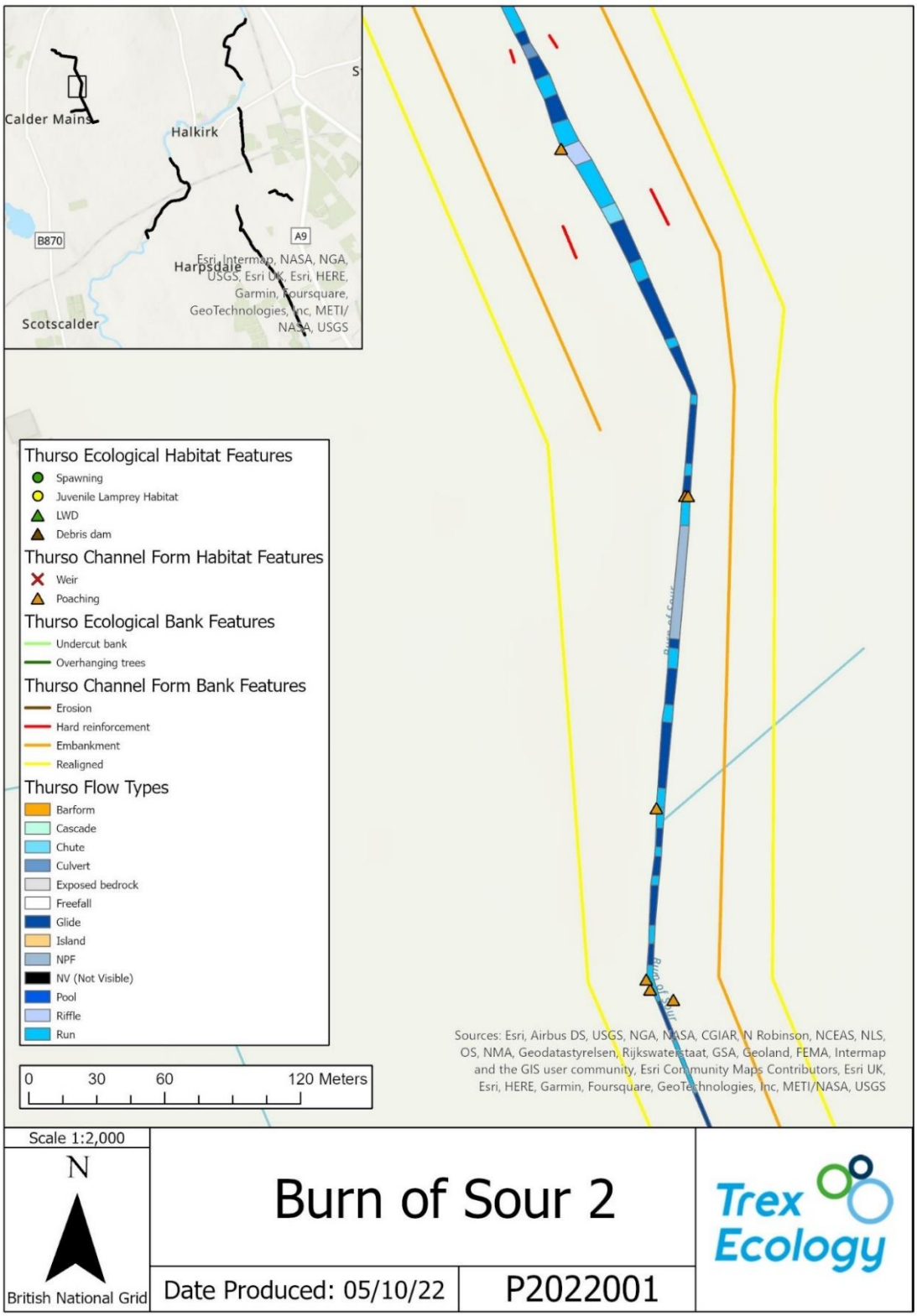
C2.7. Burn of Carnavagry, detailed walkover, map 2

C2.3 Burn of Sour

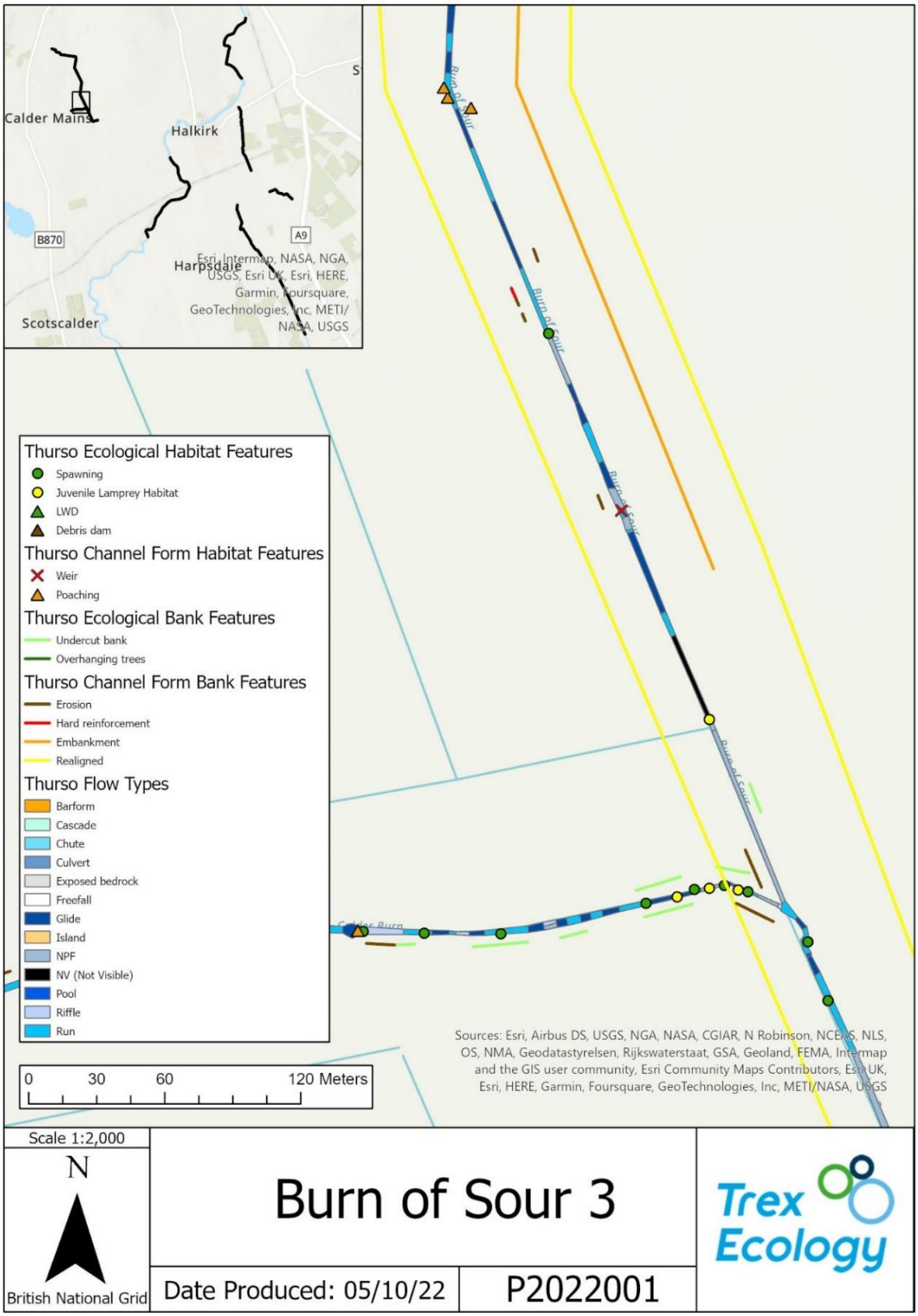
The maps for Burn of Sour are set at a scale of 1:2,000.



C2.8. Burn of Sour, detailed walkover, map 1



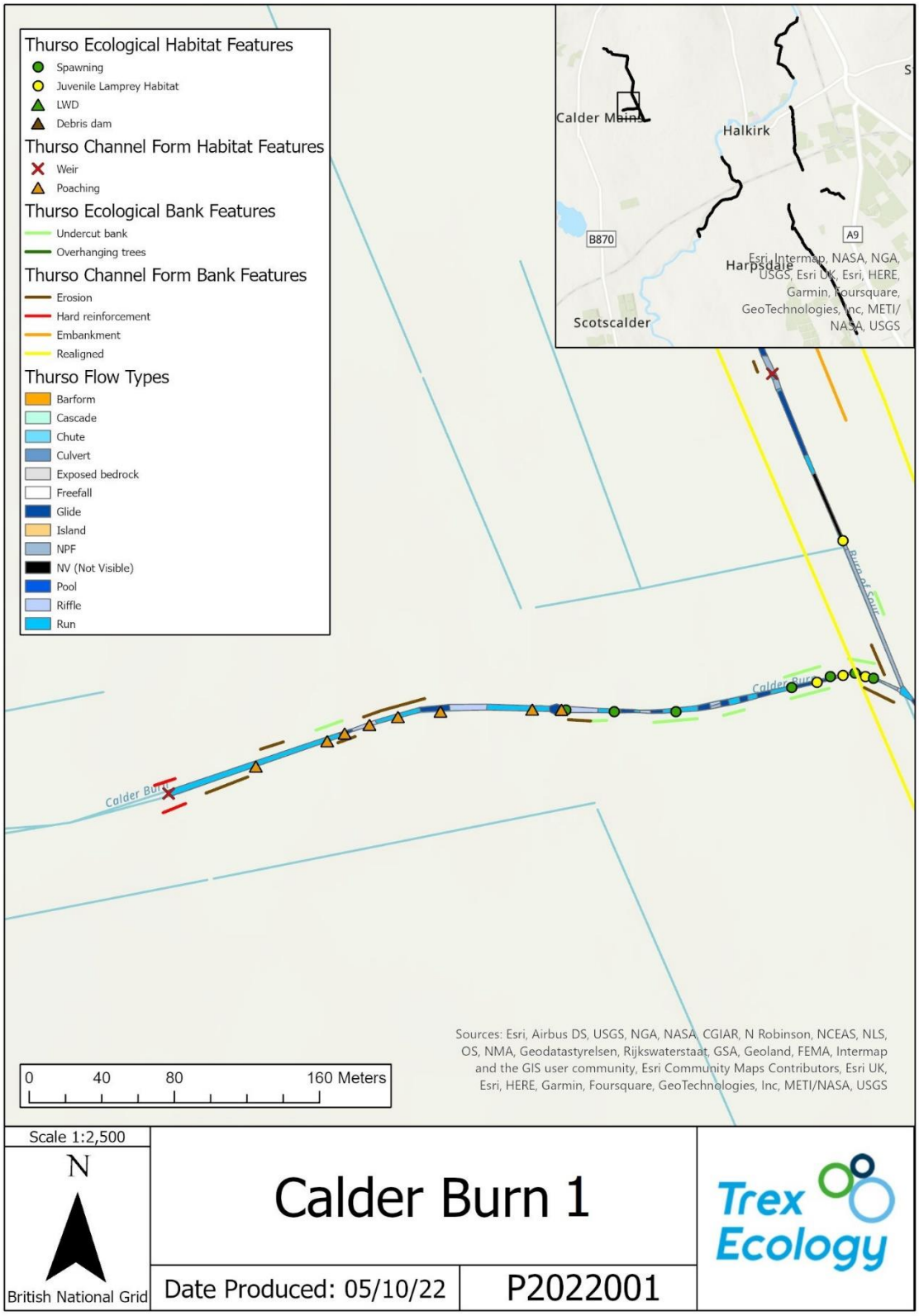
C2.9. Burn of Sour, detailed walkover, map 2



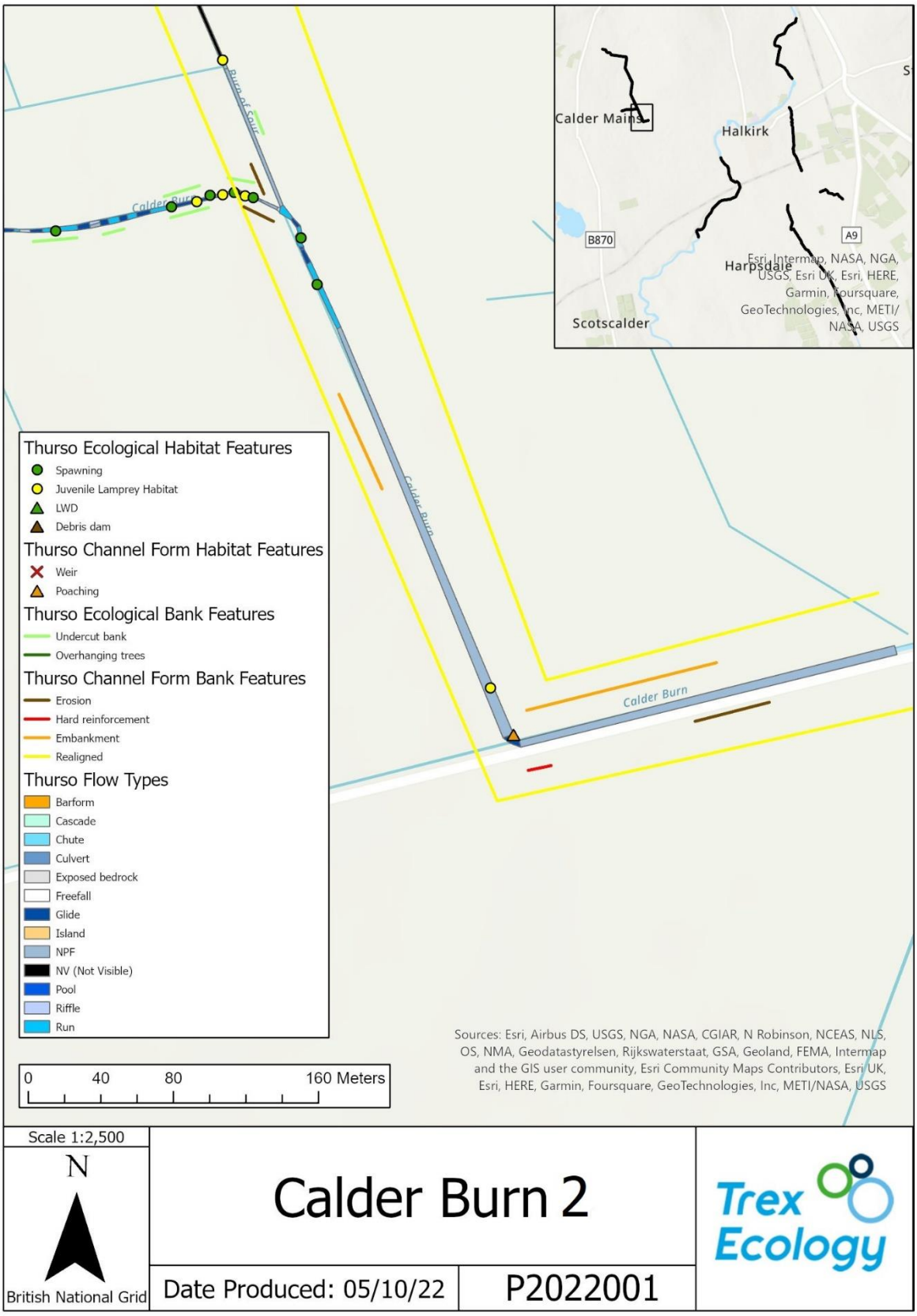
C2.10. Burn of Sour, detailed walkover, map 3

C2.4 Calder Burn

The maps for Calder Burn are set at a scale of 1:2,500.



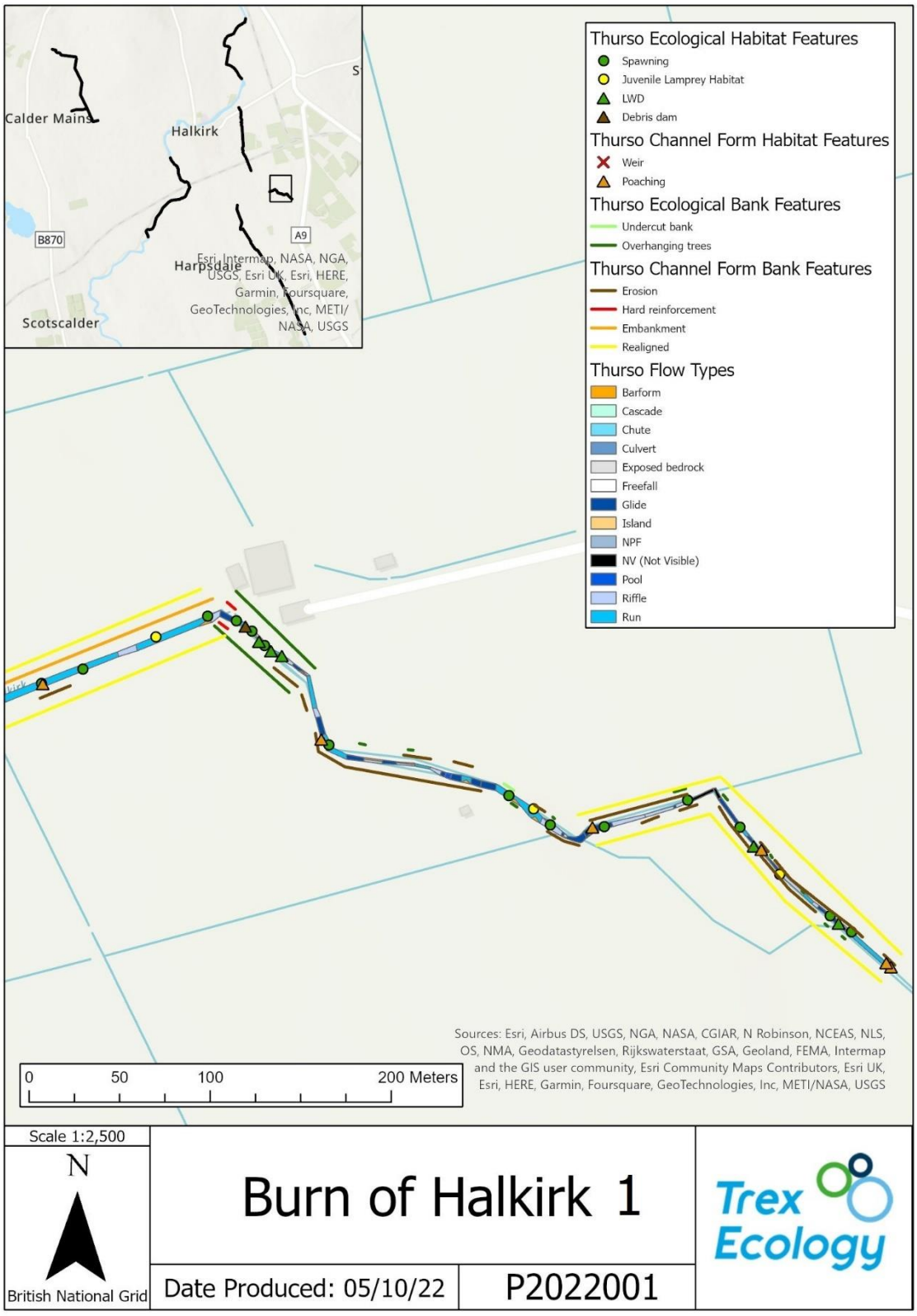
C2.11. Calder Burn, detailed walkover, map 1



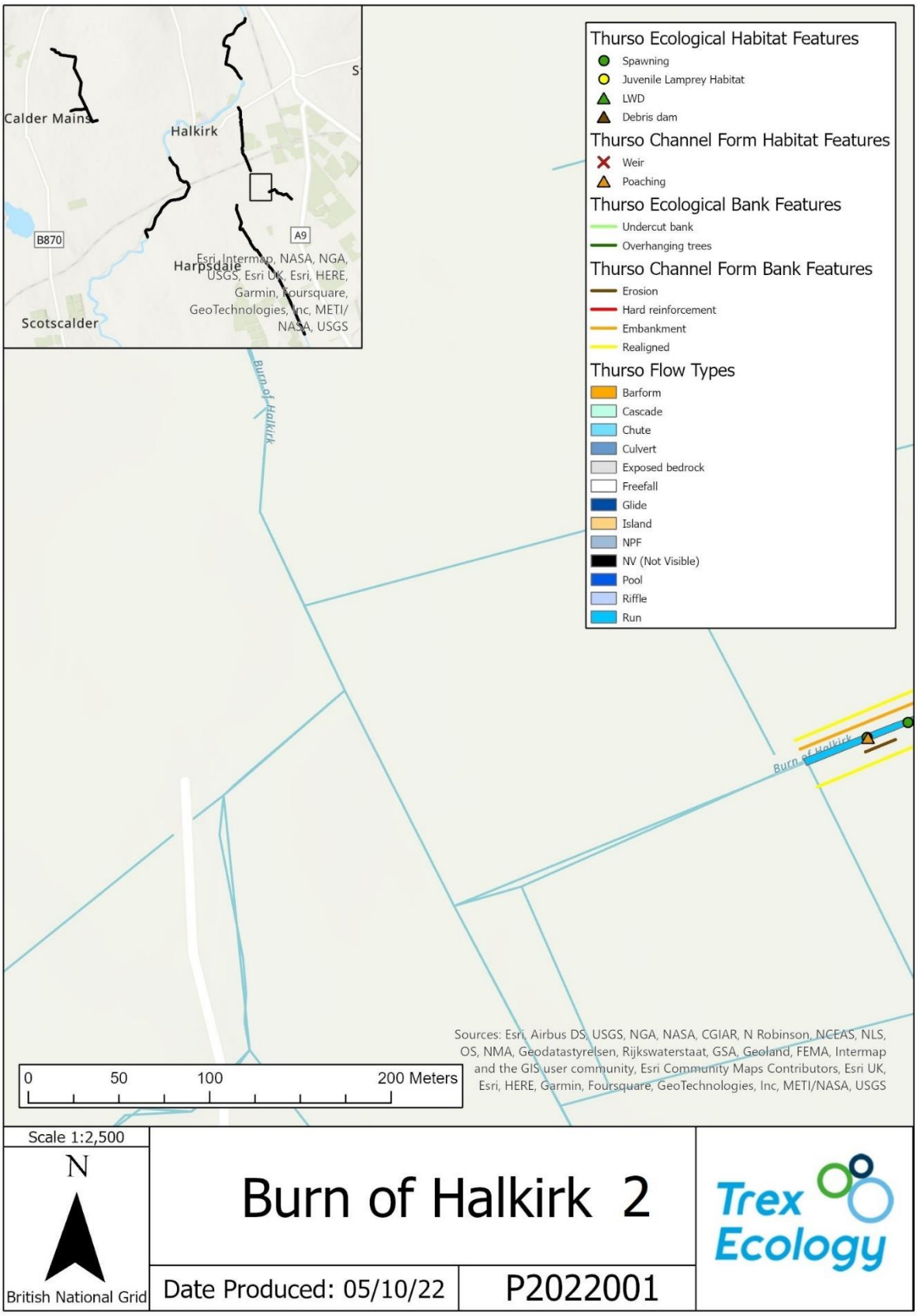
C2.12. Calder Burn, detailed walkover, map 2

C2.5 Burn of Halkirk

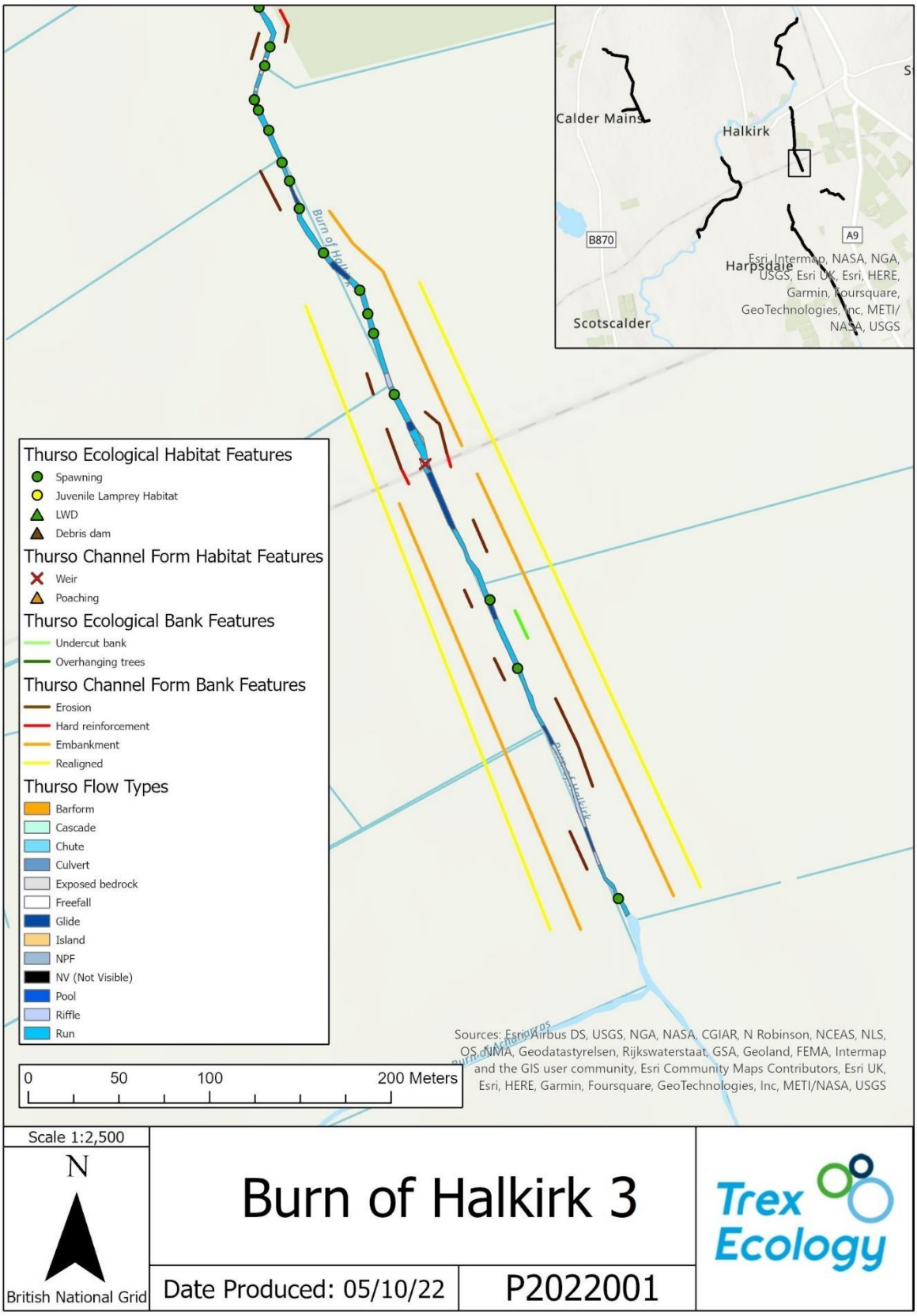
The maps for Burn of Halkirk are set at a scale of 1:2,500.



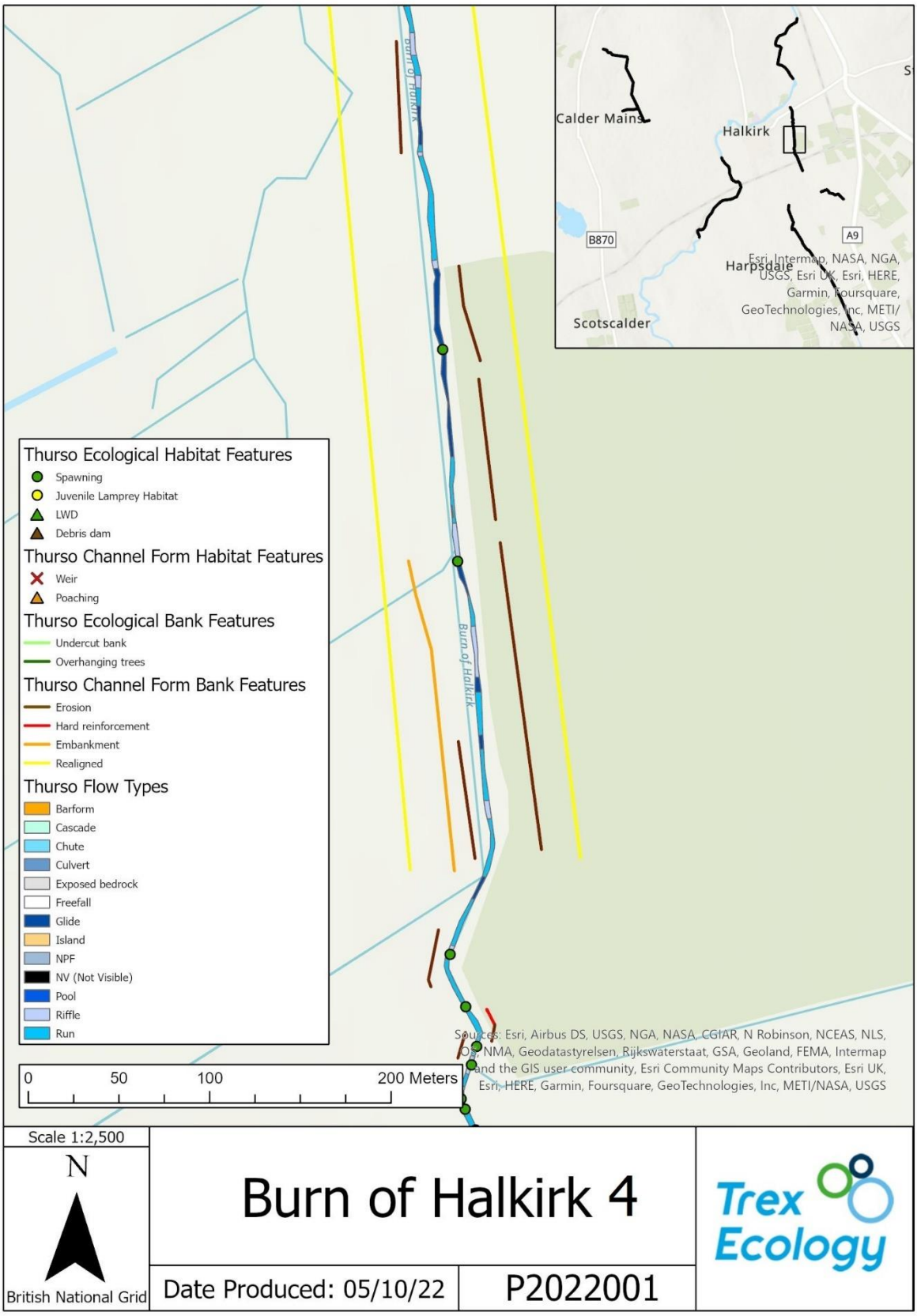
C2.13. Burn of Halkirk, detailed walkover, map 1



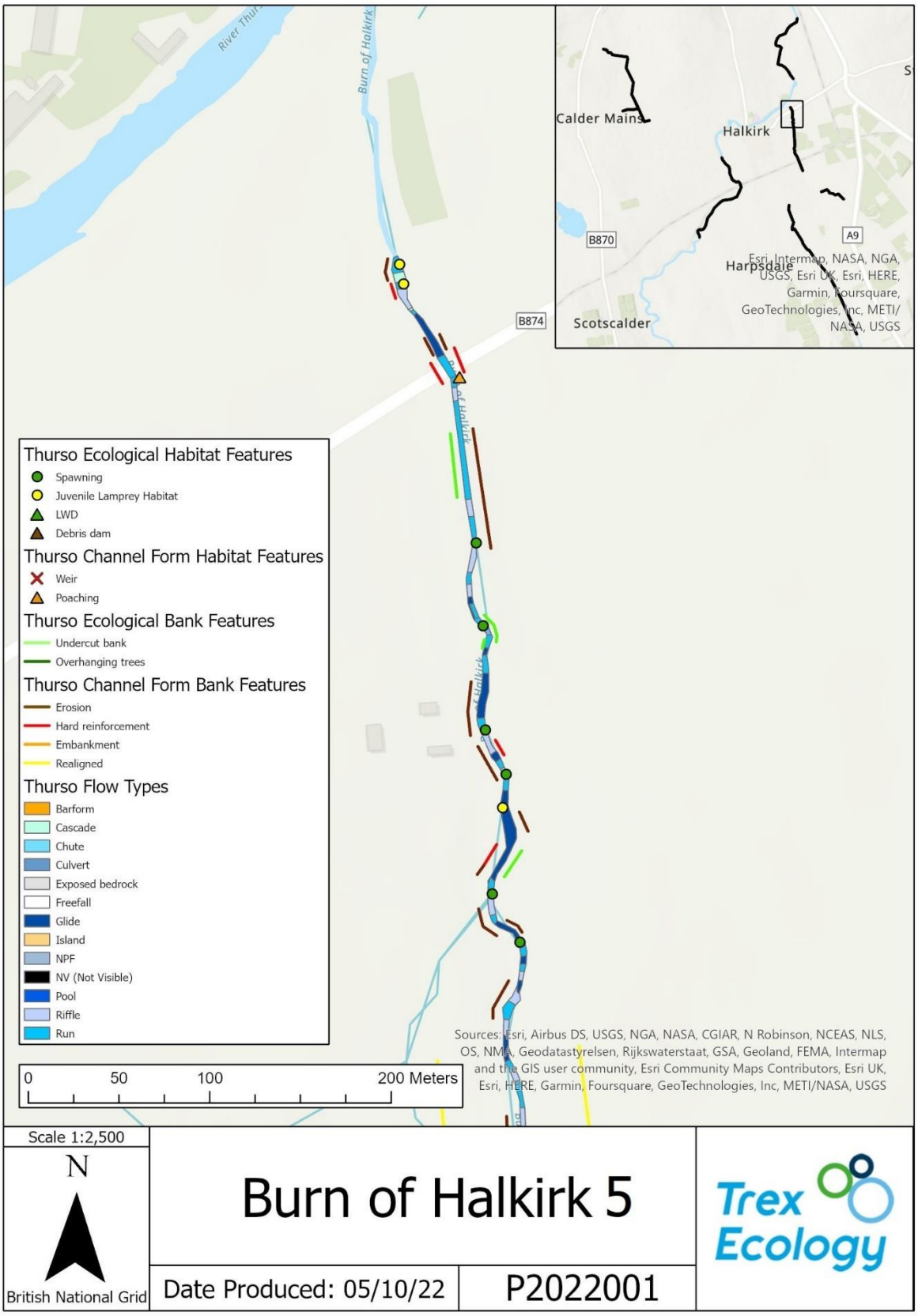
C2.14. Burn of Halkirk, detailed walkover, map 2



C2.15. Burn of Halkirk, detailed walkover, map 3



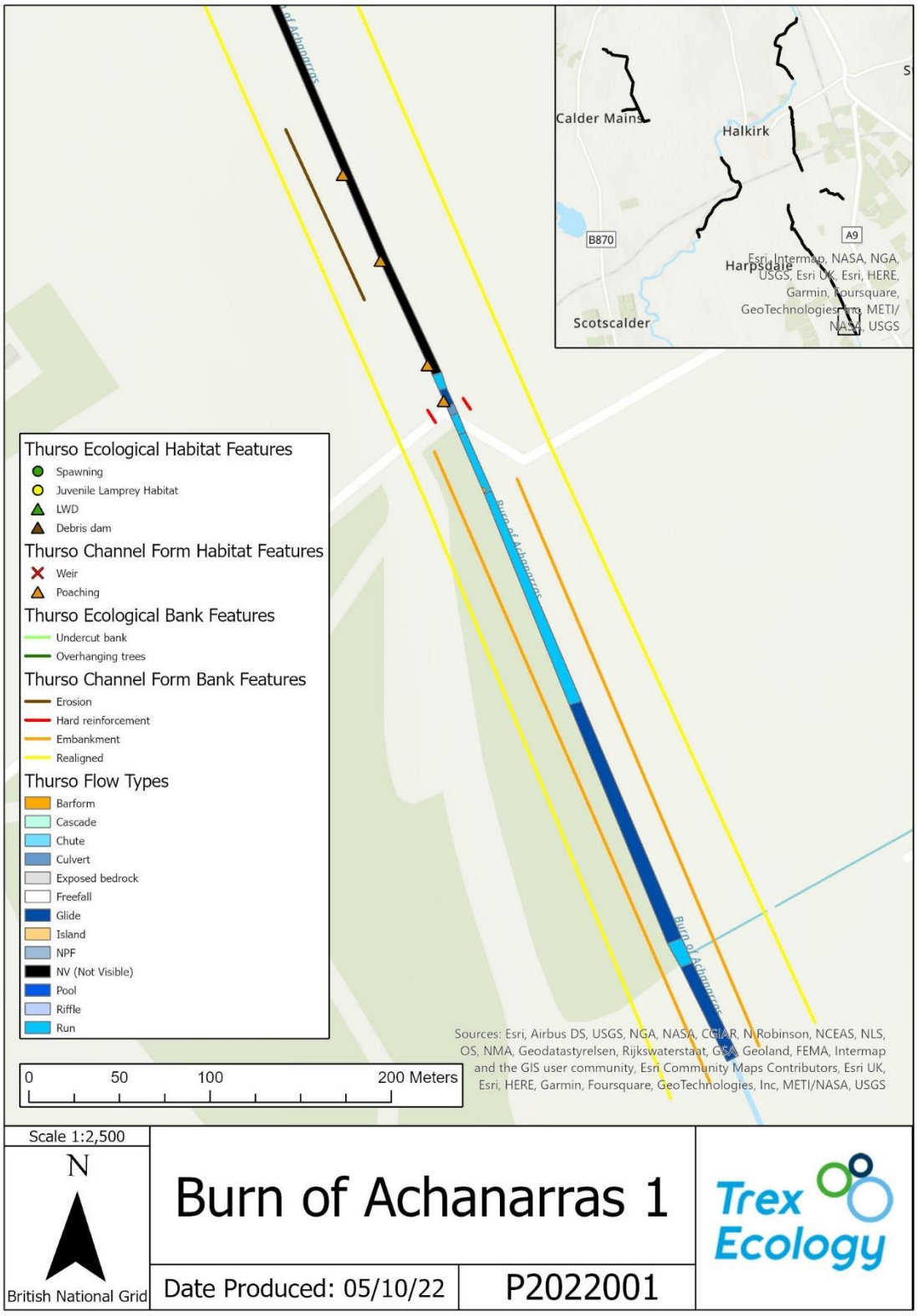
C2.16. Burn of Halkirk, detailed walkover, map 4



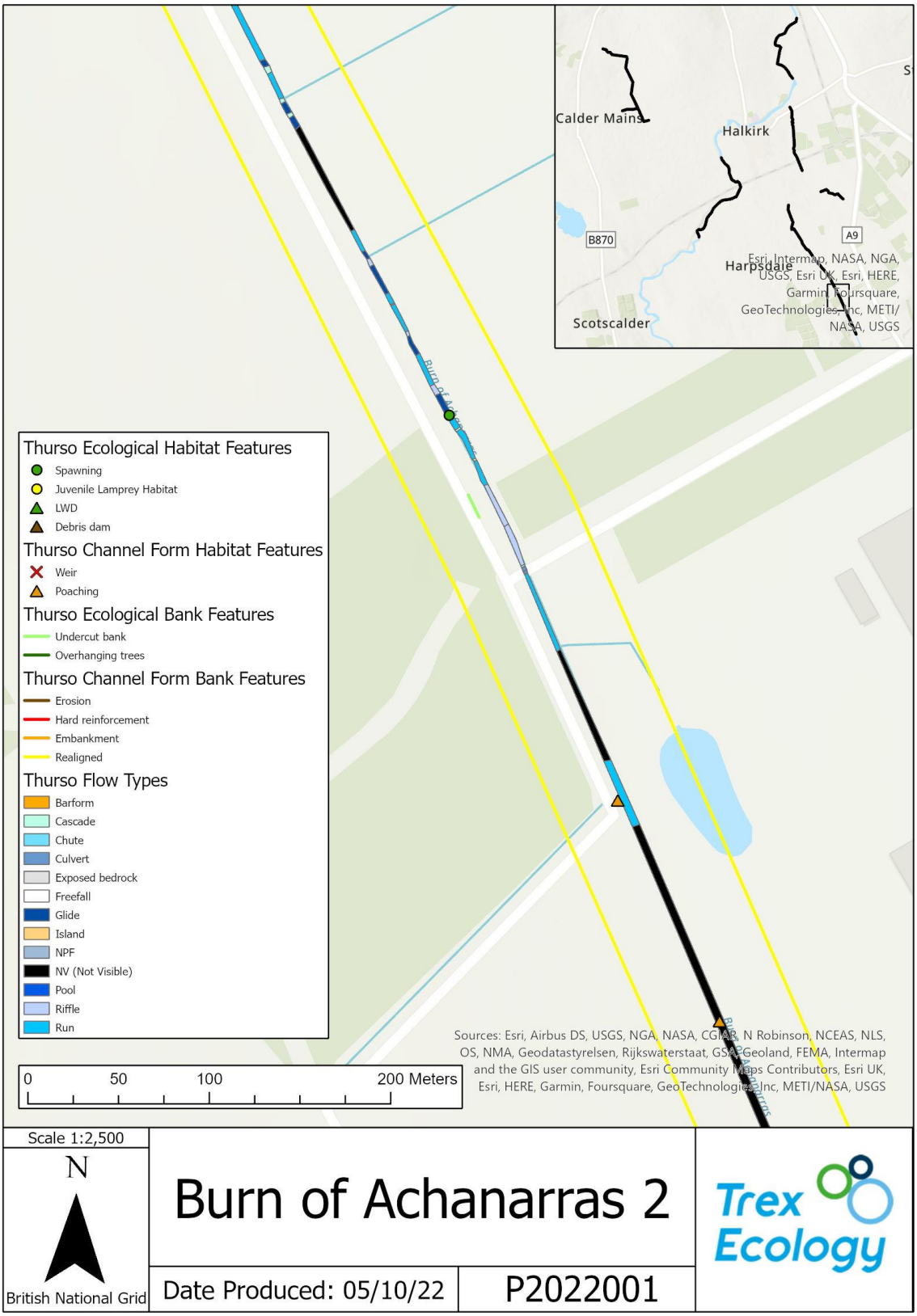
C2.17. Burn of Halkirk, detailed walkover, map 5

C2.6 Burn of Achanarras

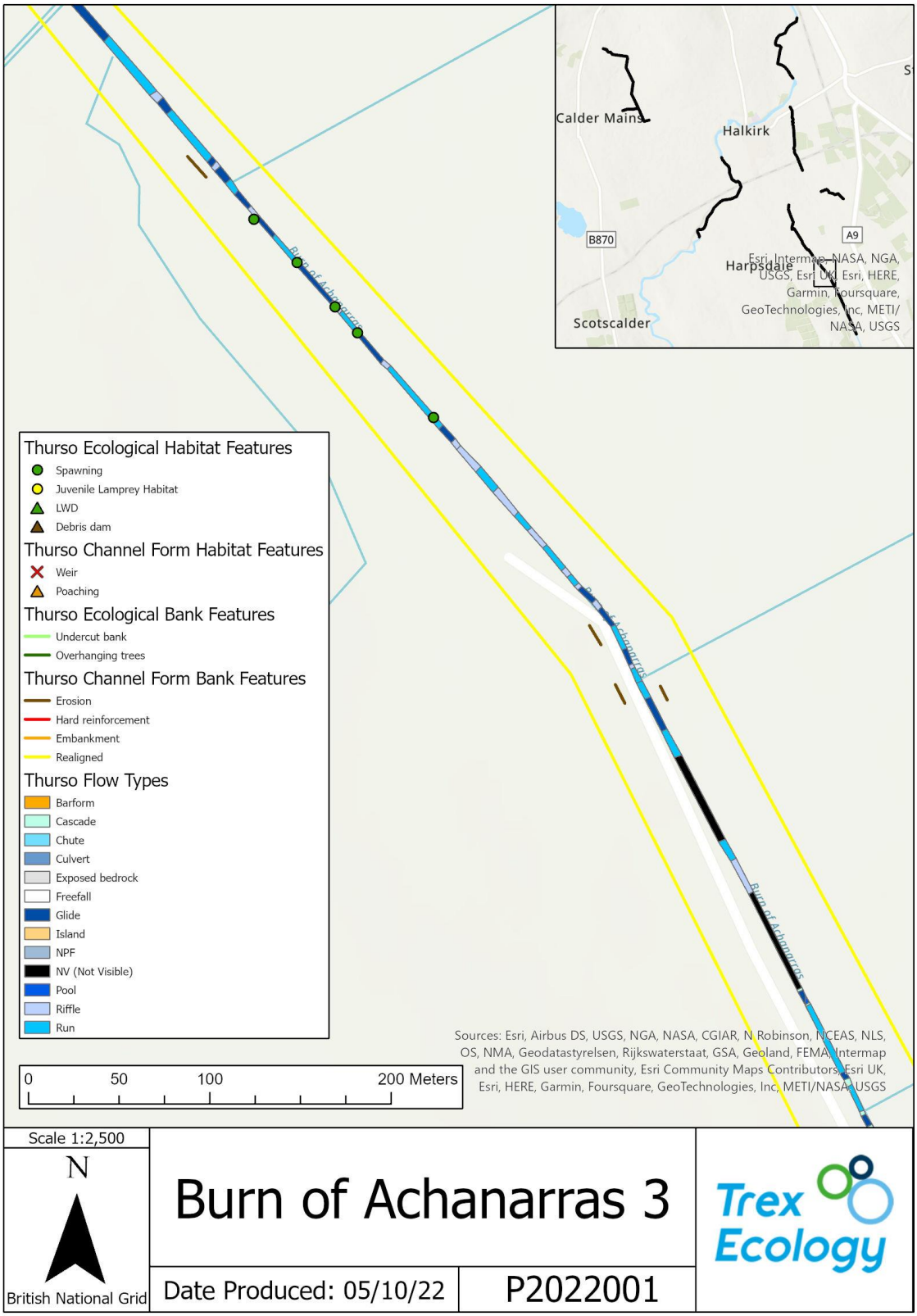
The maps for Burn of Achanarras are set at a scale of 1:2,500.



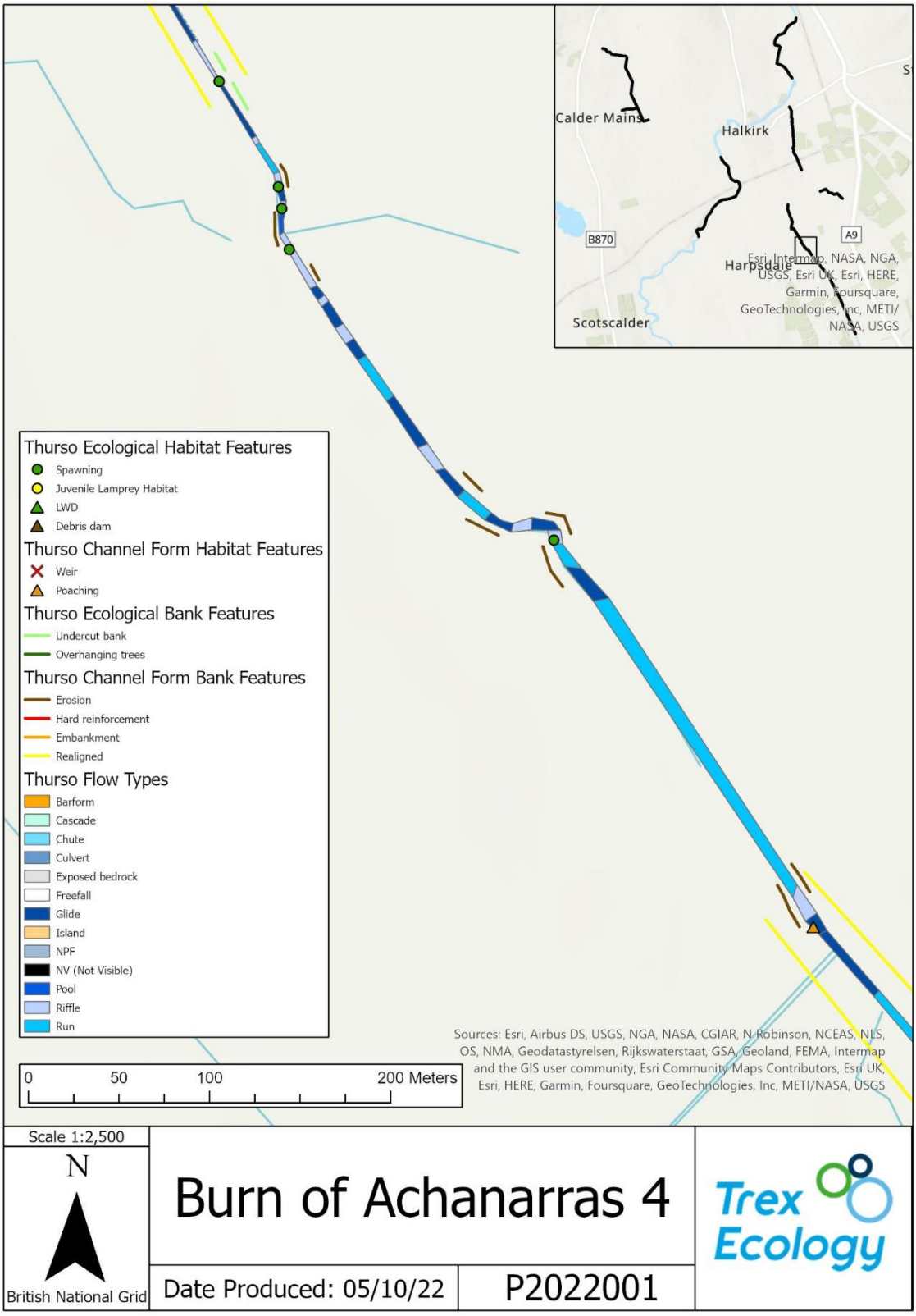
C2.18. Burn of Achanarras, detailed walkover, map 1



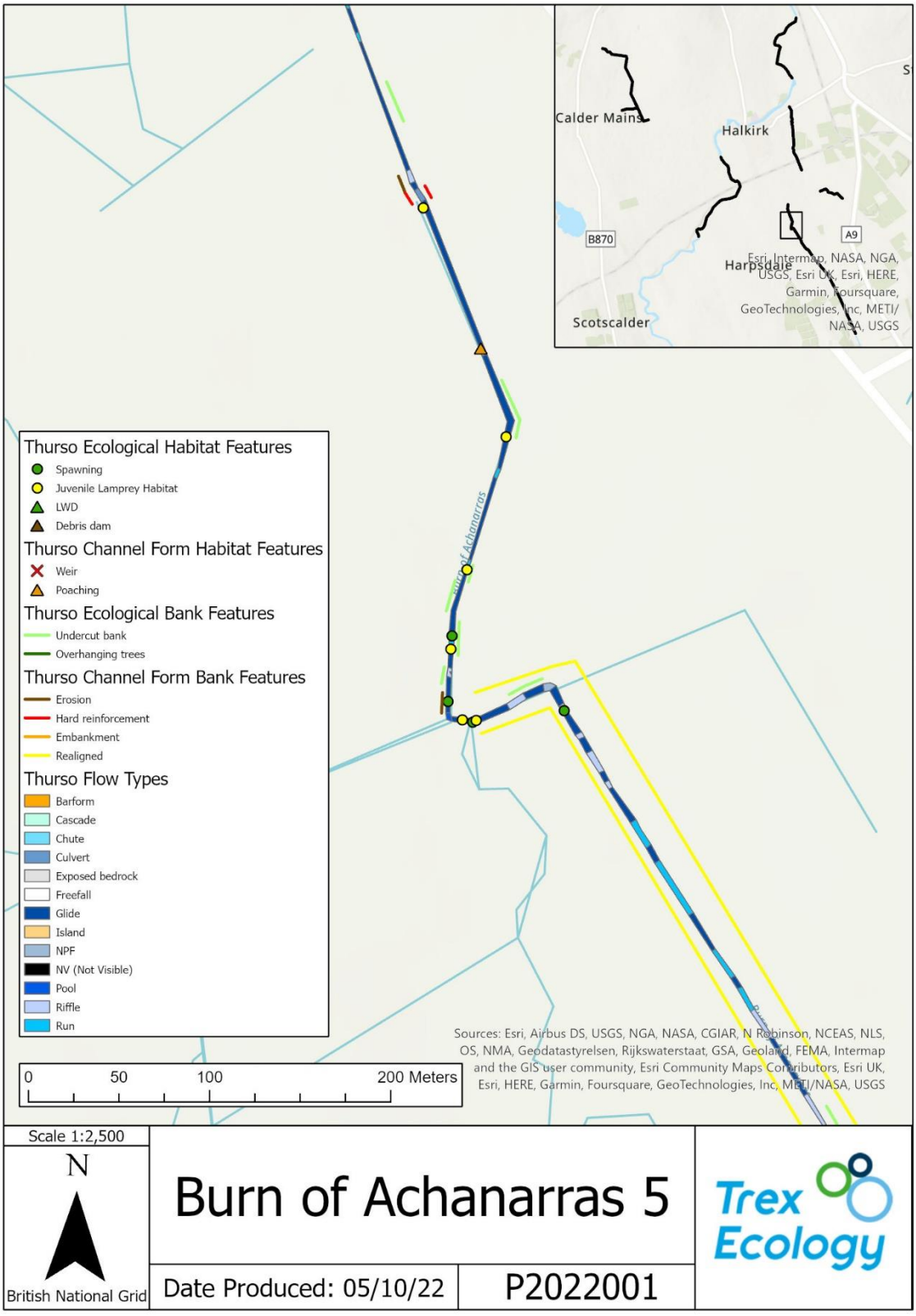
C2.19. Burn of Achanarras, detailed walkover, map 2



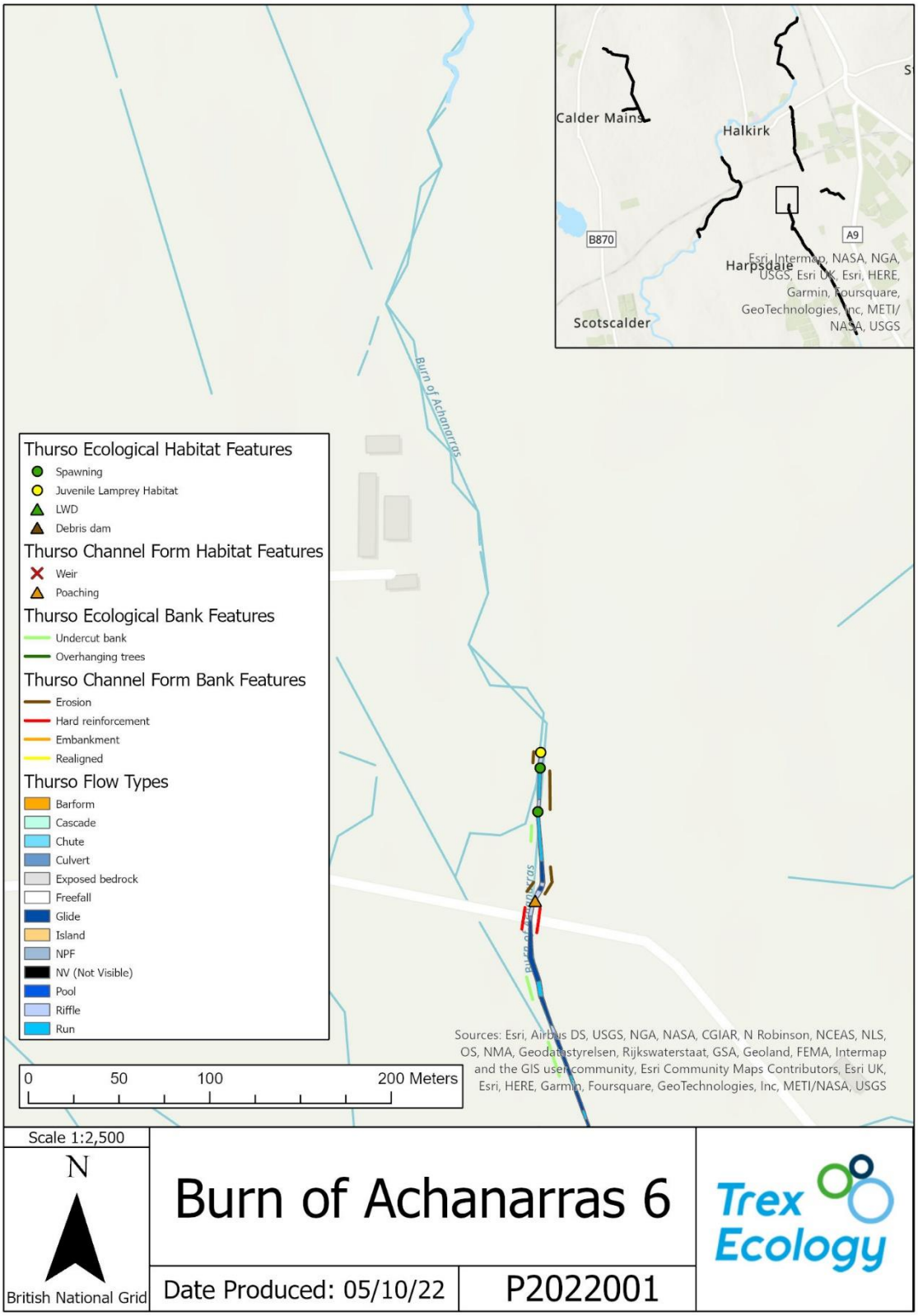
C2.20. Burn of Achanarras, detailed walkover, map 3



C2.21. Burn of Achanarras, detailed walkover, map 4



C2.22. Burn of Achanarras, detailed walkover, map 5



C2.23. Burn of Achanarras, detailed walkover, map 6